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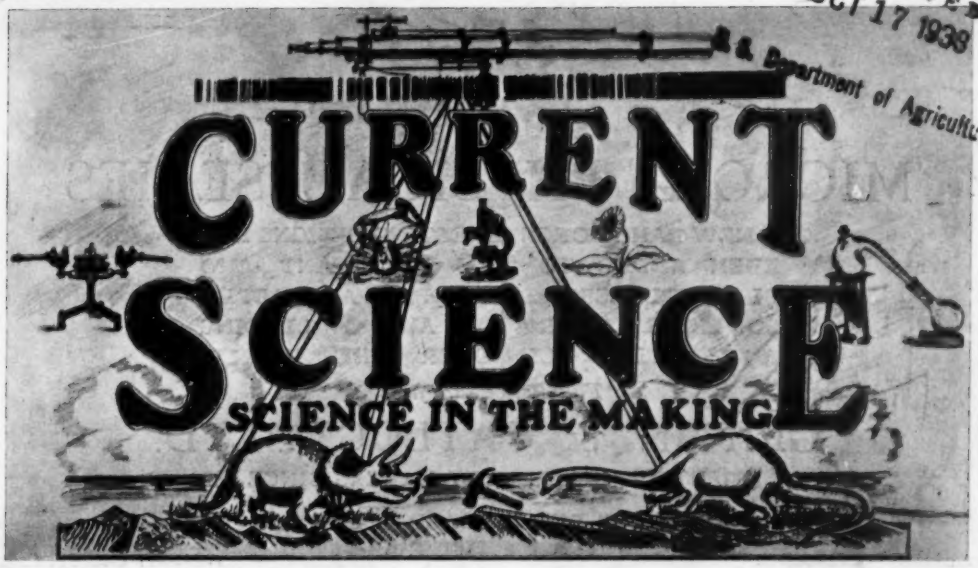


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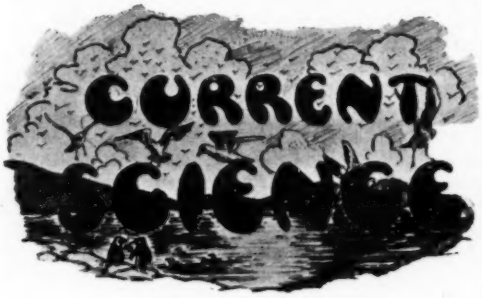


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CONTENTS.





## University Reform—II.

WE are indebted to the courtesy of one of our editorial co-operators for a copy of the Report of the Punjab University Enquiry Committee. This document which in several particulars adopts the conclusions of the Sadler Commission Report, provides nevertheless many important and illuminating suggestions of reform. It will be remembered that the Committee was instituted by the Government of the Punjab as a result of the acceptance by the Legislature of a resolution moved in 1931 by Khan Bahadur Mian Ahmed Yar Doultana. In the course of the debate speeches were made urging the appointment of a Committee to investigate the administrative details of the University and to suggest reforms for the better control of affairs. The Committee's terms of reference were restricted to a survey of minor issues such as the composition and powers of the University authorities, the income and expenditure, qualifications demanded from candidates for admission to the University classes and so forth and the more important University problems were left out of the purview of the Committee. Within the limits thus prescribed by the Government, the Report of the Committee, however, contrives to present a body of opinion on current educational problems and suggestions of reform which undoubtedly constitute an important contribution to the already extensive literature.

The University of the Punjab, though it is one of the younger members, has achieved a distinction which reflects great credit on the Province; among its *alumni* are found scientists, administrators, judges and writers whose names are honoured in India and abroad and the output of scientific work from its laboratories has in a great degree promoted the prestige of Indian unofficial research. In the chapter on University Teaching, the Committee make generous references to the important contributions of Professor S. S. Bhatnagar whose work on emulsions and the mechanical condition of coagills and the nature of luminescence and the other chemical implications of the Raman Effect is recognised as a real advance in the knowledge of physical chemistry. Similar references are made to the considerable amount of research work produced in the departments of Rai Bahadur Professor S. R. Kashyap and Dr. G. Mathai and Dr.

Vishwa Nath. Professor Kashyap's ecological studies of the Himalayan and Tibetan flora and his work on liverworts are held in great esteem by the leading botanists and the researches of Dr. Mathai on the marine fauna of Karachi and the cytological studies of Dr. Vishwa Nath have added considerably to the prestige of the University as one of the leading research centres in India. The share of the departments of Mathematics, History and Economics in building up the reputation of the University is not inconsiderable. Among the sisterhood of Indian Universities, the place occupied by the Punjab University is an honourable one and within a short time the research carried on in her laboratories has earned for her an international reputation to which the Report of the Enquiry Committee amply testifies. If in a university with such a brilliant record of achievements to its credit, the administrative machinery should have given occasion for criticism, the fault is perhaps due to the extensive territorial jurisdiction over which it exercises control. The Punjab University comprehends within its jurisdiction not only the Province of the Punjab but also the North-Western Province, British Baluchistan and some Indian States including Kashmir. The defects inherent in so vast and complex an organisation have unfortunately been magnified by communal schisms which led to the enquiry and we can only hope that the apprehensions entertained by some of the speakers in support of the resolution will be allayed by the recommendations of the Committee about the governance of the University.

A remedy for the universal complaint in our Indian universities, *viz.*, that the high schools do not provide adequate training for their pupils to be able to profit by university instruction is suggested by the Committee, namely, the institution of an Intermediate grade of teaching under the control of an independent Board. This institution is to be formed by the amalgamation of the Intermediate classes and the class X, which is the highest form of the secondary school. The Sadler Commission recommended an Intermediate College of two classes under a similar Board. We have read this section of the Report of the Sadler Commission and that of the Anderson Committee and we can recognise in the recommendation no merit other than novelty. These recommendations are in the nature of experiments and we fail to discover any educational justification in their support. The salvation of the universities is not likely to be achieved by truncating the courses here and augmenting them there, but by the formation of a more rational scheme which will secure the progressive development of all forms of instruction. Every reform of Universities must entail readjustments of the pre-university and secondary schools which in some cases are too ill-adapted to secure for the pupils the literary benefits for which they look forward. We would recommend that the twelve classes which precede the university, be remodelled on the following lines:

1. Primary Schools—four years including elementary grade.
2. Middle Schools—four years instead of three. IV Form of the existing High School be made the final class of these schools.
3. The Pre-university Schools—four years composed of V and VI Forms of the High Schools and the two Intermediate classes.

Many of the defects in the educational system and in the training imparted to the pupils obviously arise from faulty psychological assumptions and maladjustment of the age of the pupils to the standard of instruction to which they address themselves. There is no organising principle in the existing grades of the school system, capable of imparting an air of reality either to the content or the methods of instruction. Our suggestion which seems a radical departure from the existing educational practice, is based on the assumption that a liberal understanding is essential even for an average student and it should be thoroughly obtained by every student before he aspires for the cultural, scientific or professional specialisation of the unversity course. The grades that we have suggested fall into natural divisions in psychological conformity with the ages of scholars and the standards of instructions attempted and they are sufficiently prolonged to give unity of aim and completeness of studies appropriate to the several stages. In any plan of reconstruction the aim ought to be to represent knowledge in its wholeness and not to treat the mind of the pupils in segments, and if no reasonable time is assured for assimilation of knowledge the result must be perfunctory. There is a clear consensus of opinion that the existing grades of instruction are unable to give the pupils the fullest advantage of the educational programme which they set out to fulfil with the result that no one is prepared to assume the responsibility of

imperfections of training. A system of education whose component grades are well articulated may reasonably be expected to provide the necessary time and means for successfully completing a definite programme of work and where such a co-ordination is lacking there is inevitably a tendency for disclaiming the responsibility for work inefficiently performed. Some of the defects of the higher secondary schools arise from the inability of the department to exercise constant vigilance and to render helpful guidance chiefly on account of the increasing number and the variety of schools under its jurisdiction. The Director of Public Instruction, a generation ago, found time to visit the elementary classes and knew enough of educational theory and practice even to teach the little pupils; but to-day the number of schools and pupils is so inflated that a dozen directors will find the task of inspection in the real sense of the word, simply insuperable. Since the progress of education is measured in terms of numbers of schools and pupils, its quality is bound to deteriorate on account of want of effective and periodic supervision and of assistance in the actual day-to-day teaching, apart from all other causes. The redistribution of classes such as we suggest may hopefully be expected to improve the existing unsatisfactory conditions. The first two grades of schools alone need be permitted to remain under the administrative control of the Department and the pre-university or collegiate school should be under the direction of an independent Board such as the one suggested by the Anderson Committee. The independent character of the Board should not, however, preclude it from seeking and establishing opportunities of consulting the university authorities in respect of the prescription of courses of studies and the conduct of examinations, while the inspection of these institutions should be vested solely in the senior members of the university staff. We do not agree with the Sadler Commission in their views that the best interests of the university could be secured by defining the line of demarcation between university and school work at the intermediate stage. A proposal of this nature would imply that the human mind is compartmental and can be taken up in parts for treatment separately and it is this conception of mind that is at the root of all the evils in the domain of education. We are convinced that the educational process must be a continuous effort, the different stages of which should co-operate to achieve the common aim and the transition of one stage to the other must be easy and natural.

(Since writing the above we discovered that the Sadler Commission advocate the creation of a "New type of institution to be called an Intermediate College which should consist of either two intermediate classes or of these and also the two upper classes of the high schools". The latter recommendation appears to us to be the more appropriate one and the compromise suggested by the Anderson Committee is indefensible.)

The removal of the intermediate classes from the University should give it some relief, but no recommendations of a definite character are made by the Enquiry Committee to lighten the strain imposed on it by the extensive territorial jurisdiction which it exercises. Though the terms of reference do not include within their scope an invitation to the Committee to examine and recommend on the prospects of establishing teaching universities in the Punjab, still we obtain a glimpse of their views on this important problem. The claims of Khalsa College are briefly examined for its conversion into an independent unitary university and the Committee content themselves with advising the authorities that "a superior college is infinitely better than an inferior university". The Committee's suggestions in respect of the gradual evolution of independent universities are "a bold policy of higher educational developments in the mufassil" and "a bold constructive plan for mufassil development". The Committee admit that these proposals are vague, but hope that they would be made definite by "the logic of future events" implying "certain principles which if consistently pursued should result in the creation of a number of independent unitary universities".

A great part of the reproach on the governance of the University to which Khan Bahadur Shaikh Din Mahomed and Pir Akbar Ali gave vent in their speeches, is to be attributed to its unwieldy jurisdiction and responsibilities which are too wide and varied to be satisfactorily discharged. The amendments proposed by the Committee in respect of the function of the university in mufassil may not be a relief to its onerous burdens, but definite proposals for the

transformation of certain groups of colleges into constituent units of an independent university would be a more effective and speedy remedy. Having placed the Khalsa College in a category by itself and having recommended "that it should receive special consideration and representation", the Committee would obviously be glad of its elevation into a unitary university. Then it proceeds to lay down certain conditions essential to the well-being of the proposed university and one of these is that "as Khalsa College is situated outside the city of Amritsar, there should be no objection to colleges within the city being connected with another university or authority should they so desire". This option will tend to emphasise the communal character of the Khalsa College the removal of which the Committee urge and it will not strengthen the financial resources of the "potential university". If a number of constituent colleges were to become vital members of this proposed university there is greater likelihood of the Committee's recommendation that it "should not attempt to traverse the whole field of university education" but should "concentrate its energies and resources on a few departments of study, especially those of the professional type" will have some chance of fulfilment. A self-contained or independent university with limited resources should have the means of spreading its faculties over a number of integral colleges instead of concentrating them in one centre. The Khalsa University should be permitted to evolve on its own lines and develop an individuality without becoming complemental. It seems to us that the Sikh community with their enthusiasm for the promotion of higher learning ought to be proud to have a university of their own and, without impairing their cultural traditions, ought to make it sufficiently catholic in its organisation and outlook.

The other recommendations of the Committee are cautious, designed to meet the specific problems falling within the scope of enquiry and their application will probably be found satisfactory. Given the spirit of co-operation and willingness to serve, the province of the Punjab with her great cultural and material resources is bound to become one of foremost centres of learning in India, and her endeavours to augment this distinction will be watched with sympathetic interest by her sister provinces.

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## Acknowledgment.

WE have pleasure in tendering our warmest thanks to the authorities of the Osmania University for the munificent grant for *Current Science* of Rupees Three Hundred in perpetuity. The Government of H.E.H. The Nizam of Hyderabad has always taken a leading part in the promotion of learning and science and the establishment of Osmania University is intended to preserve and advance Islamic culture in conjunction with Western science. With practically unlimited financial resources of the State and supported by the energetic forward policy of its enlightened ruler, the State and the University, we anticipate, will be able to achieve the happiest results. We shall watch with sympathetic interest the progress of this infant institution.

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# Further Observations on the Distribution and Associations of *Lantana camara* Linn in Hyderabad (Deccan).

By M. Sayeeduddin, M.A., B.SC., F.R.M.S., *Professor of Botany*, and Abdus Salaam, B.A., *Osmania University*.

IN a previous communication* attention was drawn to the fact that lantana is fast spreading in Hyderabad City and its environs and that it is often to be found along with Cactus (*Opuntia dillenii*). With a view to determine the mode of distribution and association of lantana with Cactus and other plant species, we proceeded to Vikarabad, a distance of 43 miles from Hyderabad, stopping at various places on the way to study the nature of vegetation.

Within 10 miles of the City, we found that in 95 per cent of the cases, lantana was growing amidst Cactus which forms almost a continuous hedge all along the road. In this part of the district the soil is chiefly of the *morum* type which is made up principally of coarse and fine gravel. Between the 10th and the 18th miles, Cactus was almost absent having been destroyed either by the cochineal insect or by fire. From about 15 miles out of Hyderabad, lantana was mostly seen with the spiny shrub, *Gymnosporia montana* of the *Celastraceæ* family. Occasionally these two were also seen in association with *Anona squamosa* Linn. Further on, lantana was found growing with *Dodonæa viscosa* Linn (Sapindaceæ). At different spots lantana had divorced its former associates and was in company with *Butea frondosa* Roxb. and Acacia (sp?) forming a consociation in which it was dominant. A striking association was met with at a spot about 24 miles from Hyderabad City where lantana, *Gymnosporia montana*, *Butea frondosa*, *Tectona grandis*, *Dodonæa viscosa* and *Gloriosa superba* were all growing together. The last-named plant has been found for the first time on this side, and it may be of interest to note that we found only one within a distance of about 45 miles. As we approached Vikarabad we could see all the hillocks covered with luxuriant growth of lantana which showed all shades of colours—crimson, pink, yellow and white.

In Vikarabad itself lantana had entirely displaced Cactus as a hedge plant.

To obtain a preliminary idea of the distribution of lantana and its associates a representative area of about 2,500 sq. yards was chosen and the vegetation mapped out on a chart. The results showed that lantana is the most prominent form of vegetation

**Fig. 1.**

Showing Lantana and Cactus growing together.
*L*—*Lantana camara*.
*C*—Cactus (*Opuntia dillenii*).

while *Dodonæa viscosa* and *Zizyphus œnoplia* are next in prominence. A few Acacias and groups of *Gymnosporia montana* are also to be seen. The other forms of vegetation were not seen in any large numbers.

In his paper on "The Hyderabad State Ornithological Survey, Part I" Salim Ali has drawn attention to the fact that bulbuls, mynas, babblers and such like birds visit lantana for its fruit. The observations of the present authors have confirmed the above findings and have shown that birds are chiefly responsible for the rapid spread of lantana. Our studies have shown that many of the birds visiting lantana often follow up with eating the fruits of Cactus. Lantana seeds are thus dropped amidst Cactus bushes so that eventually lantana springs up in the midst of the latter. In regions where Cactus is not prominent, lantana seeds are merely dropped at random by birds as the birds fly from place to place.

* *Curr. Sci.*, **1**, 330, 1933.

Since lantana bush is highly prolific and large numbers of berries are eaten by birds it would follow therefore that the seeds get well disseminated in a very short space of time.

It will be seen from the above that there is a grave danger of lantana rapidly spreading throughout Hyderabad State. The method of destroying the Cactus through the agency of cochineal insect has already been discovered but the problem of eliminating lantana is still awaiting solution.

## Biology: its Importance in Modern Education.

By P. W. Gideon, M.A.,

*Department of Biology, Karnatak College, Dharwar.*

ONE of the most important and remarkable developments of modern times has been in the study of Biology. Educated men have only very recently recognised the fact that this science is in a large sense the foundation of nearly all forms of human progress.

In the past few years vast advances have been made in all the sciences, and in the realm of the Physical Sciences particularly, investigations and discoveries and their practical application to production have resulted in an immense increase of material wealth. This increase, however, is swallowed up by the drain due to the destructive activities of animals and plants which as parasites, carriers of disease germs, and destroyers of crops, are slowly gaining a dominance in the world. Their activities are a menace which unless checked may lead ultimately to the degeneration of the human race. We are awakening to the fact that human efforts in checking this colossal drain on the wealth of nations can only be successful if undertaken on a national basis. A nation's health and efficiency is the health and efficiency of its citizens, and unless this is of a high standard national wealth and prosperity will suffer.

The first step in this great campaign is the education of the general public in the fundamental principles governing life—the laws of health, the functions of the body in health and disease, the chief types of animals and plants beneficial or dangerous to human health, the rôle of animals and plants in the spread of disease and the dangers of uncontrolled human reproduction, especially in the undesirable classes of humanity. Mass ignorance in these respects has undermined the health of nations, incapacitated millions and endangered the health of the fit.

The two main channels for the drain of the world's wealth are through human disease and animal and plant pests, and the progress made hitherto by experts has been almost entirely in the field of cure rather than prevention.

In the problem of disease we have left the task to the medical fraternity. It is impossible for medical men and other scientists alone, with all their knowledge, experience and willingness to serve, to combat disease brought about through ignorance. For every individual cured through the corporate knowledge of doctors and other scientists, there are tens of others who contract disease through that arch enemy, ignorance. The need for more doctors and more money to heal the ever-increasing numbers of suffering humanity will obtain scant relief as long as we fail to change our methods of approaching the problem. A nation's knowledge of the means of preventing disease is probably the biggest and most important step in man's warfare with disease.

In the problem of animal and plant pests similar conditions prevail. Crores of rupees are annually lost in India through the devastating depredations of insects alone. Add to this the wealth lost by other animal and plant pests and the figure far outstrips the wealth that can be accumulated through the combined achievements of all modern science.

The world can never be adequately grateful to the workers in the physical sciences whose achievements and discoveries have contributed much to the progress and prosperity of the world. Admirable as the progress and effect of these achievements may be, the world has not yet found an effective check to the drain of human life and wealth. Indeed we owe it as a tribute to these silent workers to specialise and concentrate on a study of the comparatively neglected Biological Sciences; a knowledge of which is absolutely essential for conserving the health and prosperity that the Physical Sciences have won for us.

Such development in the medical and

economic aspects of Biology may give rise to a new problem—the dangerous increase in human population. Over-production in any commodity is to-day recognised as a major economic problem, and over-production in the human race is perhaps one of the biggest obstacles to human progress. Hence the need for scientific control of human reproduction so that the quality and quantity of human offspring may be such as would promote the health of the race, and as could be supported by the material resources of the country. Unintelligent and uncontrolled reproduction, especially in the undesirable classes of humanity so far, has resulted in a dangerous increase of unwanted and uncared for children, defectives, insane, feeble-minded, habitual criminals and paupers, constituting a big financial burden on the honest citizen and on the nation as a whole. The decrease in the undesirable classes does not necessarily involve the increase of the better stocks. Even legislation will be of no avail unless there is a wide-spread appreciation of the problem; and a study of Social Biology, impressing on man the need for selective breeding so as to eliminate those defects as would hinder man in his struggle for existence, is as imperative as the other aspects of Biology.

The need for the universal study of Biology has been felt in the countries of the West, but the need in India is even more imperative. Even among the literate population of this country how many know that—

(*a*) Malaria, in spite of our knowledge of its cause, means of transmission and methods of prevention, destroys, directly or indirectly, millions of people every year, more or less incapacitates several millions more, and is probably the cause of over one-half the entire mortality of the human race.

(*b*) The average annual cost of Malaria in Bombay City alone exceeds fifty lakhs of rupees.

(*c*) Plague in India takes a toll of several hundred thousand lives every year.

(*d*) Over half a billion people in the world are infected with Hookworm, which feeds on blood from the walls of the intestine, sapping the vitality, poisoning the system, stunting the mental and physical growth of man, and causing that general laziness, stupidity and anæmic condition so characteristic of the Indian labourer.

(*e*) In India a very large proportion of the diseases is due to the wrong habits and customs of the people, coupled with an ignorance of the main sources of contamination; inasmuch as pools, tanks, wells and rivers in India are very important sources of contagion where hundreds of people use unsuspectingly the water for domestic and other purposes, ignorant of the fact that one diseased person could contaminate the whole tank and spread disease to several hundreds of healthy persons.

(*f*) Syphilis is yet one of the principal causes of insanity, paralysis, still-births and barrenness in the civilized world. A great deal of time, money and energy is wasted by well-meaning people in trying to lessen these social diseases by appealing to the higher instincts in man. Admirable as these methods may be, morally, they can only influence the very few, being impracticable in stemming, generally, those urges for which life exists. It is time we recognised human instincts and human cravings as rising even above the highest moral and spiritual instincts man is capable of, and worked for a practical means of solving the problem of disease even through life's strongest urges.

The importance of these diseases is due to their rapid transmission and consequently wide prevalence, and where lakhs of rupees would hardly suffice to merely keep those diseases in check, it would mean an extraordinarily small expenditure to educate the people in the essentials regarding the origin, spread and prevention of these diseases.

There is no doubt that such a dreaded disease as syphilis, which causes untold misery to mankind, is probably one of the easiest diseases to prevent. If humanity were aware that the syphilis spirochæte takes some time to get into the blood stream, and can easily be killed by disinfectants while still on the outer surface of the skin, nine-tenths of human misery and financial loss caused by this disease would disappear. What is true of syphilis is equally true of many diseases, the means of prevention being very simple and requiring only a well organised system of teaching the essentials for living a healthy life in a disease-ridden world.

It is only a thorough knowledge of the dangers of these diseases and a knowledge of the methods of prevention that can materially lessen the terrible destruction to human life and the enormous waste of man's financial resources.

*(To be continued.)*

## History of Science as related to Civilisation.*

By Sir Martin Forster, F.R.S.

IT was indeed a happy inspiration that led Mr. V. Subrahmanya Iyer, former Registrar of the University, to found a periodical celebration of an event so auspicious as the Silver Jubilee of the accession of His Highness the Maharaja, Founder and Chancellor of the Mysore University. I have been honoured by the University Council with an invitation to deliver the sixth of these commemorative lectures, whose declared purpose is to show how the application of scientific methods may "promote soundness of judgment, freshness of outlook and appreciation of higher human values".

On several recent occasions, attention has been directed to the value of the training offered to the non-scientific citizen by the history of science. This movement has its origin in an increasing suspicion that in England the time devoted to laboratory practice in schools is tending to become excessive; and as Indian educational methods are based largely upon Western usage, the growth of opinion which this view involves is deserving of close attention here. More particularly is this the case because the cost of providing laboratory instruction, whether in schools or universities, is very heavy; and at a time like the present, when every item of proposed expenditure, both private and public, demands careful scrutiny, the question whether substantial outlay on materials and appliances really achieves a commensurate benefit becomes important.

Stated otherwise the point is this. Although the current century has witnessed a greatly increasing occupational absorption of men trained in various branches of science, their fraction of those engaged in all employments taken together must remain very small. It is therefore reasonable to ask, is it profitable for the State to provide an expensive form of school-training framed as if all those who receive it were embryo professional scientists? There can be no question that every individual who is privileged to vote should have some knowledge of the fundamental relation of science to the State, but cannot this be conveyed without giving him at the outset a training he might expect to receive if destined to embark on a scientific career?

The basic idea underlying the new movement is that a more generally useful approach to scientific method and scientific ways of thought is the historical one. Every intelligent mind finds attraction in biography, because when faithfully presented this offers the encouraging picture of shortcomings besides virtues, and thus makes us feel more at home even with outstanding personalities. An honest biography levels while it stimulates, and if with these effects the true bearing of science on civilisation be conjoined, this form of instruction can be made most fruitful. It fortunately happens that the history of science, more readily than general history, lends itself to this treatment because its duration, or at least the period of most flourishing development, extends over little more than a century. Consequently its basic facts are more surely ascertainable, many being within the recollection of living people. If this advantage were applicable to general history, much of the rubbish unseasonably uttered about the superiority of the "good old times" would be self-condemned, and much of the discontent prevailing now, as it has prevailed throughout the history of the world, being avoidable, might be avoided.

In designing a course on the history of science appropriate for students who will not for the most part become specialists in science it will be desirable to select the biographies of men whose discoveries may be definitely correlated with improvement in our ways of living and our outlook on life. If examined from this standpoint the whole subject will yield some surprises. Let us take an example that was very much in all our minds two years ago, being the centenary of Michael Faraday's discovery of electro-magnetic induction on 29th August, 1831. It has been claimed that "no other experiment in physical science has been more fruitful in benefit for mankind." All scientific men will agree that the claim is defensible, but the biography of Faraday may be less impressive in a course of science-history for the normal student than

* Sri Krishnarajendra Silver Jubilee Lecture delivered on Saturday, 2nd September 1933.

it is for the professed scientist. Because although his experiments were fundamental, an equally fundamental experiment in the same field had been made by the Danish philosopher Oersted in 1820, he having in that year discovered that a magnetic needle is deflected by a voltaic current; while several other contemporaries of Faraday, notably Arago, Ampère and Humphry Davy were fruitfully engaged in similar studies. In fact, Sir Ambrose Fleming has recorded that "nothing is more remarkable in the history of discovery than the manner in which Ampère seized upon the right clue which enabled him to disentangle the complicated phenomena of electrodynamics and to deduce them all as a consequence of one simple fundamental law, which occupies in electrodynamics the position of the Newtonian law of gravitation in physical astronomy."

To avoid misunderstanding, I must emphasise the point I desire to make, namely, that the transcendent importance of Faraday's work is not so readily appreciable by the normal citizen as by the professional student of science. Although the group of inventions developing the modern dynamo are actually derived from his great discovery that by cutting lines of magnetic force with a conductor, a current of electricity is generated in that conductor, the effect of this discovery on social conditions was long delayed. The modern power-machine, or dynamo, converts mechanical energy into electrical energy, but its development into a form providing cheap and abundant electric light involved numerous factors with which Faraday was not concerned. These depend first on finding the most convenient arrangement of the conductor as related to the magnet, and may be said to have reached their commercial stage in the Gramme-machine of 1870; but they required also those improvements of the arc and the incandescent electric lamp which took place during the ten years following. The scientific men engaged in these developments were very numerous indeed, and therefore, while Faraday's discovery serves to focus the public mind on the benefits accrued, the history of its application is too complicated for general assimilation.

In striking contrast with so devious and highly technical a chapter in science-history are the profound and clear-cut social effects resulting from the discoveries of Pasteur. These originated in a chance appeal for advice from a distiller regarding his fermentation process, which led Pasteur, then Dean of the Faculty of Sciences in Lille, to observe under the microscope that when fermentation was healthy the yeast globules were almost round, but that an acid fermentation was accompanied by elongated cells. This occurred in the summer of 1856, and thereon he wondered whether he might not be confronted with a principle common to all fermentations, namely, that each fermentation arises from its own type of micro-organism.

The consequences of pursuing this idea represent a startling revolution in common thought and in surgical practice throughout the world, because, after a bitter controversy and by methods of experimentation both careful and convincing, Pasteur finally demolished the hypothesis of spontaneous generation. On 7th April, 1864, he concluded a famous lecture at the Sorbonne with these words: "There is now no circumstance known in which it can be affirmed that microscopic beings come into the world without germs, without parents resembling themselves. Those who affirm it have been duped by illusions, by ill-conducted experiments, spoilt by errors that they either did not perceive, or did not know how to avoid."

The fundamental experiments of Pasteur founded the modern science of bacteriology, which he himself did so much to develop until his death in 1895, and their social effect was immediate. The British surgeon Lister had assimilated the idea that infection of surgical wounds—then causing frightful mortality in even the best-conducted hospitals—might be due to the action of living organisms, and beginning in 1864 he proceeded to verify this theory by his aseptic treatment of wounds, using for that purpose carbolic acid. All the antiseptic methods in practice to-day are the direct results of his teaching. It will thus be recognised that for the normal citizen, whose main concern lies in the civilising or socially ameliorating effects of scientific discovery, the biography of Pasteur will be found more impressive than that of Faraday.

For it follows that not only surgery, but general pathology, has profited incalculably and speedily by his work and teaching. While studying anthrax, he introduced the now common method of successive bacterial cultures outside the tissues infected,

and in 1877 elucidated a tangle of observations connected with this venomous disease. About the same time Koch improved that method by adopting solid culture-media in bacteriological technique, in 1882 isolated the tubercle bacillus, and identified the cholera bacillus in the following year. It should now be common knowledge that plague, typhoid, rabies, diphtheria, tetanus and various other pestilences have been very substantially mitigated in consequence of these pioneer investigations, and it will be agreed that the biographies of those patient and courageous men who have provided their fellow-creatures with weapons to combat such fell diseases and thus to preserve many millions of lives, are as worthy of attentive study by the youth of the world as are the biographies of the kings, emperors, generals and ecclesiastics who have destroyed millions.

Social consequences to a scientific discovery of another type cluster round the hydrocarbon benzene. By a coincidence, Faraday figures here also, because he discovered it in oil-gas in 1825; but that chapter in the history of civilisation which might appropriately be called the "Benefits of Benzene" was actually opened by W. H. Perkin in 1856. In this year, while hoping to synthesise quinine, he discovered by accident the artificial colouring-matter, mauve, which paved the way to a vast series of new products contributing inestimably to the comfort, health and æsthetic satisfaction of mankind.

The great impetus given by Perkin to civilisation arose from the fact that he founded, with his own hands, that branch of manufacture known as the organic chemical industry. Prior to 1856, the so-called heavy chemical industry was well established, flourishing predominantly in England. It embraced the large-scale production of acids, alkalis, bleaching-powder and soap, but the colouring-matters, drugs and perfumes then in common use, being all derived from natural sources, were limited and, compared with current prices, costly. When Perkin found mauve to be an excellent dye for silk, he found also that in order to produce it in marketable amounts he would require large quantities of nitrobenzene and aniline, which hitherto had been handled only in the laboratory. Mansfield had just devised the principle, still followed, by which benzene could be obtained commercially from coal-tar naphtha, when the skill and enterprise of Perkin enabled him to produce from benzene on an industrial scale first the nitrobenzene, and thence the aniline required for manufacturing his new artificial dye. He developed this novel industry during the succeeding years, being instrumental in marketing artificial alizarin among other colouring-matters. About 1874, however, competition by factories established on the Rhine a few years earlier, compelled him to dispose of his own factory, to which he could not bring the necessary increased capital, and for which he could not find suitably trained subordinates. Until his death in 1907 he successfully devoted his energies to purely scientific research.

Meanwhile there had sprung into being an entirely new manufacturing technique, the ramifications of which became incredibly wide-spread. A contributory factor of great importance was the prodigal employment of university-trained chemists by the German factories above mentioned, at that time a new principle. The heavy chemical industry itself received a stimulus from the observation that for many purposes the organic chemical industry found fuming sulphuric acid more convenient and efficient than oil of vitriol, and satisfaction of this demand led to an increased interest in catalysis as a principle having wide industrial application, the full effects of which were demonstrated by the European War most disastrously prolonged for three years by its incidence.

Probably the first noticeable result of Perkin's discovery was a multiplication of new dyes and the displacement of madder (since 1868) and of indigo (since 1897) by the corresponding products from coal-tar; but these were only the superficial signs. The outstanding characteristic of the organic chemical industry, distinguishing it from all other industries, lies in the bewildering number of by-products associated with many of its operations. To maintain economic levels of production, uses for these by-products must perforce be found, and the search for remunerative applications has led to the manufacture of numerous new drugs, dyes and photographic materials. This has involved the development of an entirely new, and in some cases very complicated, manufacturing technique, because organic compounds, or the compounds of carbon, require very delicate handling compared with that applied to the materials concerned in the heavy chemical

industry and in metallurgy. This arises from their sensitivity to heat, and the fact that the solvents from which they are crystallised for purification belong to their own class in preference to water. Concurrently, the application of trained minds in rapidly increasing hundreds to the problems involved has given birth to great new industries, such as artificial silk and plastics, or synthetic resins typified by bakelite; besides improving beyond expectation the purification of natural products such as petroleum and sugar.

Another chapter of science-history revealing immediate and far-reaching social results from an accidental discovery is provided by the life of Henry Bessemer. This is admirably described in his autobiography published in 1905, seven years after his death at the age of 85. The three classes of iron known at the middle of the nineteenth century were not then producible in large quantities, and their cost was so high as to preclude their use for many purposes to which they are now freely applied. They were called wrought iron (almost free from carbon), steel (with a medium carbon-content reaching 2·2 per cent.) and cast iron (with increasing amounts of carbon up to 5 per cent.). Wrought iron was too malleable for many purposes, cast iron was too brittle for anything, and steel was found to be greatly hardened by sudden cooling and yet remained malleable on slow cooling. The great contribution to social welfare by Bessemer in 1856 was the discovery that molten cast iron may be deprived of its carbon by a blast of air; and that when thus purified in a suitable converter, iron may be heated easily to a temperature above the melting point of steel. Thus there could be produced in rapidly increasing quantities a new class of iron called mild steel, free from slag, and by early improvements in manufacture almost free from the highly deleterious phosphorus and sulphur.

The results of this discovery during the succeeding fifty years have been magical, because the abundance and improved quality of steel produced in England and the United States led to its adoption for constructional purposes of every kind, while the consequent facility with which other metals, notably manganese, nickel, chromium and tungsten may be added in amounts producing remarkable and convenient changes in the properties of steel has led to an enormously expanded variety of application. The machine-shop in particular has benefited by one of these in the shape of high-speed steel, containing quite large percentages of chromium and tungsten, which by causing the steel to retain its hardness at elevated temperatures enables a cutting-tool to be used in the lathe at greatly increased speeds. Thus the advantage to engineering practice has been incalculable.

The foregoing examples of science-history within reach of the normal citizen, and illustrating how his comfort and security have been augmented by scientific investigation, relate to periods just beyond the life-time of the present generation, but one which will naturally occur to many present as having taken place under their own eyes will be found in the principle of internal combustion, to which is due the tremendous development of motor-traffic. This hinges on consuming the fuel within the motive power-cylinder instead of outside, as in the steam-engine, and began with the Otto gas-engine of 1876, still used for stationary purposes. Extension of this principle to an internal combustion motor using petroleum vapour instead of coal-gas, effected by Daimler in 1885, was the first step towards the complete revolution in road transport witnessed by the present generation, accomplished by constant improvement in mechanical details of the engine, in the method of igniting the explosive mixture of petroleum vapour with air, in lubrication and in the character and quality of tires for the wheels.

Concurrently with this revolution has proceeded a revolution in the oil and rubber industries. The United States petroleum industry began in 1859 with the discovery of rock-oil in Pennsylvania, and rapidly grew to enormous proportions, products from the fractional distillation being universally adopted for heating, lighting and lubrication. The transformation of this industry due to the multiplication of motor-vehicles is two-fold, firstly in the methods of purification and distillation, secondly in the practice of cracking, the process by which fractions of high boiling point may be converted into motor-spirit. A third phase in this transformation now impending, is the production of oil by the hydrogenation of coal and coal-tar. This phase is at the development stage, but in the last few weeks a conditional remission of petrol tax by the British Government has led the Chairman of

Imperial Chemical Industries to announce that his company will proceed with a plant for hydrogenating coal at an outlay of 2½ million pounds: this follows an expenditure of one million pounds on the preliminary experiments.

It must be remembered that crude petroleum is a very complicated mixture of chemical individuals, ranging from gases of the methane type through the diminishingly volatile hydrocarbons of the paraffin series to low-melting solids like vaseline. The composition of these mixtures varies greatly with geographical origin, Borneo petroleum, for instance, being rich in benzenoid hydrocarbons. Before the more volatile fraction called petrol, or gasoline in the United States, was applied to motive internal combustion engines, it was a dangerous component of the illuminating fraction, and went largely to waste. For many years past, however, all the ingenuity of the manufacturer has been directed to conserving this volatile fraction, increasing its supply and producing it in a more highly purified condition. The demand for motor-spirit has led to these vast improvements in manufacture and to the introduction of cracking, while the resultant purity of the more volatile fraction has been an important factor in the development and multiplication of air-craft. A moment's reflection on the colossal advantages arising from the growth of motor-traffic in this country will convince you of the beneficent relation borne by scientific discovery and invention to the State, particularly as this demonstration has progressed under your own eyes.

Another revolution still in progress relates to the preservation and transport of food as effected by canning and refrigeration. Although having less practical interest for the people of this country than for Europeans and Americans, whose customary diet has been vastly improved and varied by these processes, it nevertheless will benefit indirectly the population of India because it has developed a food-science, including recognition of the vitamin principle and a more scientific evaluation of nutritional factors, which cannot fail ultimately to improve the public health. The speed of development and widening scope of this new knowledge form a separate chapter of science-history, but an illuminating example is given by the history of solid carbon dioxide, known as Dry Ice in the States and Drikold or Cardice in England, in which countries it is now increasingly used as a refrigerant. The commercial production of this material began only in 1924, and the manufacturing tonnage for the United States is as follows :— 1925, 170; 1926, 525; 1927, 1,715; 1928, 7,000; 1929, 22,000; 1930, 40,000.

Enough has now been said to demonstrate the very direct bearing on our individual modes of living effected in recent years by scientific discovery and invention; and to show that in many cases this may be recognised and traced by the normal citizen untrained in scientific practice. Many other examples will occur to your minds, such as line and wireless telegraphy and telephony, motion-pictures, hydro-electric power generation and non-ferrous metallurgy. A distinct, but very important section of science-history lies in the realm of ideas as a stimulus to experiment. This may be illustrated by the theory of evolution as taught by Darwin and his followers; the cell-theory as developed by Schleiden for plants (1838) and by Schwann for animal tissue (1839); and finally, the conception of the atom as formulated by Dalton and replaced in very recent years by the captivating theories of Rutherford and Bohr.

The conclusion that I now submit is this. If civilisation be defined as reclamation from barbarism, as a process of developing the arts and refinements of life, no century in the world's history has been more fruitful in civilising agency than the last hundred years. In that period have been recorded unhappily the average number of human conflicts, political and martial, differing only in their weapons and their staging from the ceaseless human discords common to general history. On this murky background, however, has been painted with radiant brush the promise of a colourful era which the nations may enter when they unite in recognising political quarrels to be less advantageous than the co-operative harvesting of Nature's gifts as a consequence to elucidation of natural laws. This desirable step towards popular enlightenment would be hastened if the more fundamental of these laws, and the history of their application to modern progress, were allowed increasingly to replace general history in the school curricula, so that the changes now rapidly transforming the art of living may be brought into proper perspective and healthily developed.

Prominent in the study of these changes must be the life-history of the people most concerned in them. The lesson from all these lives, for all of us, is their thoroughness and beneficence. If half the attention of schools, colleges and mature citizens that has been given to Alexander, Cæsar and Napoleon had been devoted to Faraday, Pasteur, Lister and Bessemer, the world would be a different and a better world to-day. Because, not only were these men remarkable discoverers, to whom we owe far greater security and amenity of life than our forefathers could enjoy, but their methods of work and their outlook towards their fellow-beings display just those qualities most needed for smooth and continued progress of civilisation; patience, honesty and thoroughness in their labour combined with inexhaustible goodwill towards mankind.

## Letters to the Editor.

### On the Discovery of *Prothallus* in Indian *Ophioglossums*.

THE genus *Ophioglossum* has interested a number of botanists in India and abroad on account of its peculiar systematic position in the Pteridophyta. Attempts are often being made to throw more light upon its life-history simply by the study of the sporophyte generation. But the gametophyte generation has not been so well studied owing to several difficulties in its way. It is, however, to be noted with satisfaction that it was studied in a few species of *Ophioglossum* during the latter half of the last century and in the beginning of the present century by some eminent workers. Mettenius, for instance, studied *O. pedunculosum* as far back as 1856, while Dr. Lang studied prothalli of *O. pendulum* in 1902; and Bruchmann studied the *Ophioglossum vulgatum* in 1904. Later on Dr. Campbell confirmed the results of these authors by his study on *O. moluccanum* and *O. pendulum* in 1906. Since then no attempts appear to have been made either by way of confirmation of old results or by way of investigation of new ones.

It was in 1930 that my attention was drawn to this subject by some remarks on *Ophioglossum* made by Prof. Dixit in his book and I began to study it, more critically since 1931. My observations by the cultural methods—later on confirmed by the gametophytes that I could obtain in nature—I have been able to discover the prothalli of some four Indian species which appear to be different from those that have been studied by previous botanists such as Dr. Lang and others.

The peculiar methods used in obtaining them have been summarised in my "*Rationale* of the germination of the spores in *Ophioglossum*" which will soon appear elsewhere.

My further researches on this structure have given me a wealth of new facts and allowed me to throw a good deal of light on some previously unsolved points. It was very kind of Prof. Dixit to confirm my results later and I offer my sincere thanks to him and to my two colleagues Messrs. Deshpande and Kanitkar.

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*August 15, 1933.*

### Theory of Parallel Deposits of Solute by Evaporation from the Walls.

D. OWEN before the Physical Society of London, 22nd May 1932, gave a demonstration of the difference of heights to which (1) fuchsin, (2) salt solution, and (3) a mixture of the two solutions respectively would rise in a strip of filter paper dipping into these solutions.

In repeating the experiment, we noted the formation of very beautiful parallel deposits. One of us, in a paper on the variability of Avogadro's Number (S. Ray in *Zeit.f.phys. Chemie*, **128**, 186, 1927) has shown that in a solution or sol the concentration variation with height follows a curve as in Fig. 1 while in another paper on A Physical Factor in Liesegang Phenomenon (*Koll. Zeit.*, **44**, 277, 1928) the same author has shown that this concentration distribution has the possibility of explaining Liesegang phenomena. Thus, if in the graph, AB is a line parallel to OY, the Y axis, such that tangent at C is parallel to the tangent at D, it means at these two points not only are

the concentrations identical but also concentration *gradient*. The appearance of the graph of concentration on the OY axis is

very much like that of half dome resting on half a pillar, or in other words it is a vertical longitudinal section through a dome resting on a pillar.

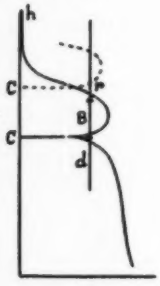


**Fig. 1.**

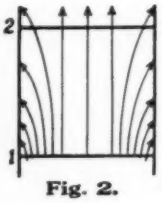


**Fig. 2.**

In our graph, C is in the pillar region and D in the "dome". This distribution, however, is true only for a column in *equilibrium* at the same temperature throughout. Now in a rise (or descent) of a liquid, a static equilibrium at constant temperature is not obtained, but we have a dynamical process with difference of temperature along the column of which the article mentioned above on Variability of Avogadro's Number takes no cognisance. If therefore in a rise from the bottom at D, the conditions of temperature, pressure, etc., make themselves identical with that at C, then it stands to reason that in the "dome" region, at D the reaction will proceed as it had at C in the "pillar" region, and instead of proceeding to the point of the spire will proceed towards C′, and the "wavelength" $a\gamma$ will repeat itself. (This viewpoint was communicated to Dr. R. Liesegang and accepted by him.)

We have in Fig. 2 a section through the thickness of the blotting paper.

Obviously, evaporation is continuously taking place all the time, the solution, and the solute is being carried upwards. Using the well-known equation* of electric and thermal conductivity or diffusion of particles having gravitational mass, the mass of salt $dq$, going up across the section 1, is

$$dq_1 = -\mathrm{KA}\left(\frac{dc}{dx}\right)_1 dt$$

where $c$ is the concentration, whilst going across the section 2,

$$dq_2 = -\mathrm{KA}\left(\frac{dc}{dx}\right)_2 dt$$

then $dq_2$ is less than $dq_1$. The difference $(dq_1 - dq_2)$ gets deposited on the face of the blotting paper. The expression for this deposit is

$$(dq_1 - dq_2) = \mathrm{KA}\left(\frac{d^2c}{dx^2}\right) \delta x \cdot dt \quad \ldots\ldots (1)$$

where $\delta x$ is the distance apart between sections 1 and 2.

Now we proceed to find another, independent, mathematical expression for this *surface* deposit. The deposit will depend upon the rate of evaporation. This will depend upon the surface evaporating and upon the humidity of the atmosphere. Or

$$\delta q \propto p\ \delta x.\phi(h)$$

$\phi(h)$ shows variation of evaporation upon "humidity" and $p$ is the perimeter of the cross section. Also the rate of deposit will depend upon the concentration at the height concerned which settles the vapour pressure, or

$$\delta q \propto f(c).$$

Combining the two variabilities in a single equation

$$\delta q = a.p\ \delta x.f(c).\ \phi(h)dt \quad \ldots\ldots\ldots (2)$$

where $a$ is the constant of proportionality.

Now to a first approximation, by Raoult's Law, we can assume

$$f(c) = (1 - kc).$$

We can also, in analogy to Newton's Law of Cooling, assume

$$\phi(h) = k_2(h_0 - h)$$

where $h_0$ is the absolute humidity required

* See "Das Ohm-Fouriersche Gesetz der Leitung," *Zeit. f. Electrochemie*, 753, 1928.

for saturating the atmosphere. Therefore our equation becomes:—

$$KA\left(\frac{d^2c}{dt^2}\right)\delta x.dt = a\,p.\delta x(1-kc).\,k_2(h_o-h)dt\,. \quad (3)$$

which may be written

$$\frac{d^2c}{dx^2} = \beta^2(1-kc), \text{ where } \beta^2 = \frac{a\,p\,k_2.(h_o-h)}{KA}$$

The solution of the equation is

$$(1-kc) = a\sin(\beta\sqrt{k}.x+\gamma) \text{ or}$$

$$c = \frac{1}{k}\left\{1-a\sin(\beta\sqrt{k}\,x+\gamma)\right\} \quad \ldots\ (4)$$

So that the concentration is varying periodically with height, the wavelength being given by

$$\lambda = \frac{2\pi}{\beta\sqrt{k}} = \frac{2\pi}{\sqrt{k}}\sqrt{\frac{KA}{apk_2(h_o-h)}} \quad \ldots\ (5)$$

Experiments to test this formula are in progress. On the face of it, it has the capacity of explaining some well-known facts in these as well as Liesegang Deposits. Thus, $\sqrt{k}$ in the denominator in (5) would make the deposits closer with more concentrated solutions. The increase with A and decrease with $(h_o-h)$ of the wave-length has also been qualitatively proved.

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*August 19, 1933.*

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## Formaldehyde-yielding Complex in the Lignin Molecule.

RAW jute freed from fatty and resinous matter as well as other impurities gives on distillation with 12 per cent HCl according to Tollen's method a distillate which contains both furfural and formaldehyde. The former is detected by aniline acetate paper which remains unchanged by formaldehyde, and the latter by Schryver's reagent after much dilution. In very dilute solution furfural does not interfere with the test for formaldehyde.

Jute after complete removal of lignin by moist $ClO_2$ gas gives furfural but no formaldehyde. Lignin obtained by 72 per cent $H_2SO_4$ or by Willstätter's method gives formaldehyde but no furfural. It has been shown from this laboratory that $ClO_2$ removes nothing but lignin from jute. Hence, lignin from jute is free from furfural but contains a formaldehyde-yielding complex. This supports the view of Freudenberg[1] that lignin contains a dioxymethylene group which is responsible for the formaldehyde.

Raw bamboo similarly treated gives formaldehyde but not de-lignified bamboo. Packing box wood also behaves similarly. Phillips and Goss[1] obtained HCHO from lignin prepared by Urban's method only. So far as jute is concerned, this is not substantially correct.

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*August 20, 1933.*

[1] *Ber.*, **60**, 581, 1927.

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## Absorption Effects in the Total Secondary Electron Emission from Metal Faces.

TWO outstanding problems in the study of total secondary electron emission from metal faces are the peculiar shape of the total emission curves and the differences observed between polycrystalline and single crystal faces.[2] No explanations have so far been offered to account for these observations.

It is well known that the mean velocity of the secondary electrons increases as the applied potential is raised, rapidly at low and more slowly at high potentials. We can now explain the above results making a few simple assumptions which do not in any manner violate the principles involved in the mechanism of secondary emission. Assuming that the secondary electrons are produced at a mean depth within the surface of the target (this depth varying directly as the applied potential V and inversely as $a$ the coefficient of absorption of the primary electrons, the constant of variation being B), and suffer absorption in travelling outwards (this coefficient being taken as $\beta$), we can show by a simple calculation that R (the ratio of the total secondary to the primary current) $= AV\,e^{-(1+\beta/a)BV}$. This leads to the conclusion that we should get straight line curves if we plot points between $\log_{10}\frac{R}{V}$ and V, the slope being $\frac{-(1+\beta/a)}{2{\cdot}3026}B$.

The results of Petry[3] and the writer[3] are found to give such straight line curves except at potentials less than about 250 volts in which range $\beta$ decreases somewhat rapidly as V is increased. The differences

[1] *J. Am. Chem. Soc.*, p. 3374, 1932.
[2] S. R. Rao, *Proc. Roy. Soc.*, **A 128**, 41, 1930.
[3] R. L. Petry, *Phys. Rev.*, **26**, 346, 1925 and **28**, 362, 1926.

between the R values of polycrystalline and single metal faces may be attributed to different B values for these faces since it is normal to expect different depths of penetration with different crystal faces, other conditions remaining the same. When the first few layers are concerned this may not be significant and this is exactly what is observed, the R values being the same at about 50 volts. The above considerations enable us also to give a natural explanation for the differences observed between gas covered and perfectly degassed metal faces. Full details will be published elsewhere.

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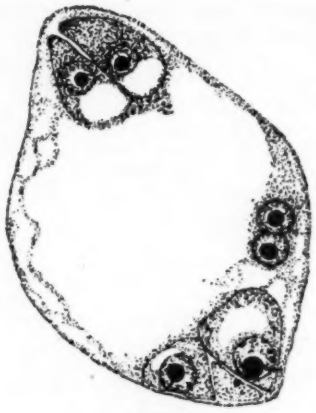
*August 22, 1933.*

## The Development of the Female Gametophyte and Chromosome Number of *Argemone mexicana* Linn.

INVESTIGATIONS on the morphology and cytology of *Argemone mexicana* have been in progress in this laboratory since the last two years and the work is now nearing completion. In a recent paper Joshi[1] has given an account of the formation of megaspores and embryo-sac in this plant. His account which is based on material obtained from only 'two ovaries' differs in certain fundamental points from our observations. In this note an outline of the development of the female gametophyte as observed by us is presented.

Joshi presumes that the archesporial cell is hypodermal in origin and this by transverse division gives rise to a 'wall cell' and the megaspore mother cell. Our observations support his statement. By the division of the megaspore mother cell a dyad is produced and the two cells of the dyad as a rule divide periclinally and produce a normal linear tetrad. The 'T-shaped' tetrad which according to Joshi is a characteristic feature of this plant, is of comparatively rare occurrence. Generally the upper three megaspores from the micropylar end degenerate and the chalazal one functions. It increases in size before division and by three successive divisions produces an eight nucleate embryo-sac. The structure of the fully differentiated embryo-sac is given below:



× 550.

It will be noted that the synergids are nearly as big as the antipodals. The egg is situated centrally between the synergids and is masked by them. The two polar nuclei lie very close to each other before fusion. The approximate sizes of the synergids, the egg, the polar nuclei and the antipodals at this stage are given below:

| | | |
|---|---|---|
| Synergid | .. | 28·6 $\mu$ |
| Egg | .. | 22·0 $\mu$ |
| Polar nucleus | .. | 8·8 $\mu$ |
| Antipodal cell | .. | 26·4 $\mu$ |

Endosperm formation commences very soon after fertilisation. The synergids are not observed at this stage, but the antipodal cells increase very considerably in size. The average dimension of an antipodal cell when the endosperm nuclei form a lining around the nucellar cavity is 154$\mu$. Signs of degeneration of the antipodals are just apparent at this stage. It thus appears that the antipodal cells of Argemone behave similarly to that observed by Huss[2] in *Fumaria*, *Corydalis* and *Papaver*.

The chromosome number of *Argemone mexicana* has been computed from the meiotic stages of the microspore mother cells and it has been found to be fourteen ($n$=14).

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I. BANERJI.
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Calcutta University,
*August 24, 1933.*

[1] Joshi, A. C., "Megaspore formation and Embryo-sac of *Argemone mexicana*, Linn," *The Jr. of the Indian Botanical Soc.*, **12**, No. 2, April 1933.

[2] Huss, G. A., "Beitrage zur Morphologie und Physiologie der Antipoden," *Beih. Bot. Centralb.*, **20**, 77-174, 1906.

## Oil-Soluble Vitamin A in Some Pulses and Fishes of Bengal.

THE importance of accessory food factors—enzymes and vitamins—is well recognised. Cod liver oil, owing to its A vitamin content, commands a world-wide reputation. However, other fish oils, such as Halibut, are being discovered with nearly sixty times the potency of cod liver oil. Amongst the Bengal fishes Hilsha (*Clupea ilisha*), Rohit (*Labeo rohita*) and Catla (*Catla catla*) are in daily use. Body, roe and liver fats of these fishes had been studied at the Bose Research Institute Laboratories and referred to in the abstracts published in the *Proceedings of the Indian Science Congress.*[1]

Vegetable oils are generally classed as "bad fats"[2] and classed with lard, which last is used in physiological control experiments. At the Bose Research Institute, Bengal, pulses have been the subject of investigation from various points of view; certain special qualities of *Cicer arietinum* have been reported in the Transactions of the Bose Institute.[3] Particular attention was drawn to the presence of carotene and its significance to vitamin A. Lovibond Tintometric measurements showed *Cicer arietinum* oil to approach cod liver oil of approved quality. Spectroscopic examination of the $SbCl_3$ blue compound also confirmed this significance[1]. Photographs taken of the spectra show absorption bands at about 610—625 $\mu$, 570—580 $\mu$ and 540—550 $\mu$, corresponding to those obtained with cod liver oil.[4] The specificity of the band at or about 620 $\mu$ is now well recognised. Hilsha fish liver oil gives a band at 500 $\mu$, which is very pronounced; the other bands are rather broad and often merge one into the others.

The subject is being further studied in its various aspects as regards keeping quality and potency. Hilsha fish oil shows variation with season, and whether the fish is roe-bearing or not. In some Tintometric measurements, the figures were as high as those of halibut oil or even higher.

Physiological observations with rats have given very promising results with *Cicer arietinum* oil. Its importance will be easily appreciated when it is remembered that Lovibond Tintometric figures for this *vegetable* oil approach closely those of cod liver oil.

Fuller details with spectrographs will be published in due course in the *Transactions of the Bose Research Institute.*

N. C. NAG.
H. N. BANERJEE.

Bose Research Institute,
Calcutta,
*August 25, 1933.*

[1] Banerjee and Nag, *Proc. Ind. Sci. Congress*, XX, Chem., No. 192.

[2] Plimmer and Plimmer, *Food, Health, Vitamins*, p. 60, Longmans, Green & Co., 1932.

[3] Banerjee, "Chemical Examination of Oils from Leguminous Pulses," *Trans. Bose. Inst.*, VII, 1931-32.

Nag and Banerjee, *Proc. Ind. Sci. Congress*, XIX, 1932, Chem., No. 211, p. 244.

[4] "Communications from the Universities of Zurich and Utrecht," *Nature*, July 1st and July 29th, 1933.

## A Note on the "New Type of Fertilization" in Plants.

VARIATION from the generally accepted view that during double fertilization in plants the primary endosperm-nucleus becomes triploid and contains 3x number of chromosomes was first reported by Ferguson.[1] She found that due to the premature division of the primary endosperm-nucleus before the discharge of the sperms from the pollen tube, one-fourth of the endosperm tissue (which is derived from the fertilized micropylar endosperm-nucleus) becomes triploid whereas the remaining three-fourths (which is derived from the unfertilized chalazal endosperm-nucleus) remains diploid. During my investigation on the embryology of some members of Solanaceæ, I have also observed this new type of double fertilization in one of the strains of 'Tomato' grown in the college experimental grounds. Here also the two polar nuclei fuse before the opening of the flower and divide as a rule before the discharge of the sperms from the pollen tube forming a small micropylar and a big chalazal endosperm cell. Fig. 1 will show that the primary endosperm nucleus has divided while the two sperms are still seen inside the pollen tube.

After the discharge of the sperms into the embryo-sac, one sperm fuses with the egg and the other with the micropylar endosperm-nucleus. The chalazal nucleus, however, divides and forms part of the

[1] Ferguson, M. C., *Bull. Torr. Bot. Club*, **64**, 657–664, 1927.

endosperm tissue which remains diploid. During the first division of the primary endosperm-nucleus approximately 24 chromosomes were counted instead of 36, the haploid number determined for the species


**Fig. 1.**

Microphotograph showing the micropylar and the chalazal endosperm cells and the two sperms inside the pollen tube.

*p.e.* Position of the egg, not in focus.
*sp.* Sperm.
*mi.c.* Micropylar endosperm cell.
*ch.c.* Chalazal endosperm cell.

being 12. This shows that the primary endosperm-nucleus is diploid (not triploid) at the time of first divison and the division takes place before fusion with the second male nucleus. It, therefore, seems to be very probable that Cooper[2] has either overlooked the chalazal endosperm-nucleus or the same was missed owing to the section being oblique. A detailed account of the observation, will shortly be published elsewhere.

PARAM NATH BHADURI.
Department of Botany,
Calcutta University,
*August 25, 1933.*

## The Quantum Statistical Theory of Fluctuation.

IN an interesting paper in *Phys. Rev.*, **21**, 672 (1923) Kar has derived some important classical relations between the different partial fluctuations, and with the help of these, and two independently derived partial fluctuations, obtained all other fluctuations.

[2] Cooper, D. C., *Amer. Jour. Bot.*, **18**, 739–748, 1931.

I have been able to generalise these partial relations with the help of quantum statistics (Bose-Einstein and Fermi). They are, in their usual notations,

$$\left.\begin{aligned}
\overline{(\delta^2_p)_T} &= \overline{(\delta^2_v)_T}\,(1 \mp y),\\
\overline{(\delta^2_T)_p} &= \overline{(\delta^2_v)_p}\,(1 \mp \tfrac{2}{3}y),\\
\overline{(\delta^2_T)_v} &= \overline{(\delta^2_p)_v}\,(1 \mp \tfrac{3}{2}y),\\
\overline{(\delta^2_E)_y} &= \overline{(\delta^2_p)_y},\\
\overline{(\delta^2_E)_T} &= \overline{(\delta^2_v)_T}\cdot\tfrac{1}{4}y^2,\\
\text{where } y &= \frac{N}{V}\cdot\frac{h^3}{(4\pi mkT)^{3/2}},
\end{aligned}\right\}\ \text{Non-degenerate (1)}$$

and

$$\left.\begin{aligned}
\overline{(\delta^2_p)_T} &= \overline{(\delta^2_v)_T}\cdot\tfrac{2}{3}\,(1 \pm 8c_2/z^2),\\
\left(\frac{10c_2}{z^2}\right)^2\overline{(\delta^2_T)_p} &= \overline{(\delta^2_v)_p}\cdot\tfrac{2}{3}\,(1 \pm 8c_2/z^2),\\
\left(\frac{10c_2}{z^2}\right)^2\overline{(\delta^2_T)_v} &= (\delta^2_p)_v = (\delta^2_E)_v,\\
\text{where } z &= \left(\frac{3N}{4\pi v}\right)^{2/3}\frac{h^2}{(2mkT)^2},
\end{aligned}\right\}\ \text{Degenerate (2)}$$

and $c_2 = \pi^2/6$ (Bose), $= \pi^2/12$ (Fermi)

where the upper sign is for Bose-Einstein statistics and the lower for Fermi. It is noteworthy that neglecting the higher correction in the non-degenerate case one gets the well-known relations of Kar.

In order to get the value of any fluctuation we must know in addition to the above relations at least two partial fluctuations. The quantum statistical values of these as obtained by me are :—

$$\left.\begin{aligned}
\overline{(\delta^2_T)_v} &= \frac{2}{3N}\,(1 \pm \tfrac{5}{8}y)\\
\overline{(\delta^2_v)_T} &= \frac{1}{N}\,(1 \pm \cdot 647y)
\end{aligned}\right\}\ \text{Non-degenerate (3)}$$

$$\left.\begin{aligned}
\overline{(\delta^2_E)_v} &= \frac{4}{21N}\,(1 \mp 25c_2/z^2)\\
\overline{(\delta^2_v)_T} &= \frac{1}{2N}\,(1 \mp 6c_2/z^2)
\end{aligned}\right\}\ \text{Degenerate (4)}$$

One readily gets from (1) and (3) for the non-degenerate state

$$\left.\begin{aligned}
\overline{(\delta^2_T)_v} &= \frac{2}{3N}\,(1 \mp \cdot 875y)\\
\overline{(\delta^2_p)} &= \frac{5}{3N}\,(1 \mp \cdot 038y)
\end{aligned}\right\}\ \ldots\ldots\ (5)$$

and from (2) and (4) for the degenerate state

$$\left.\begin{aligned}
\overline{(\delta^2_T)_v} &= \frac{4}{21N}\left(\frac{z^2}{10c_2}\right)^2(1 \mp 25c_2/z^2)\\
(\delta^2_p) &= \frac{19}{6N}\,(1 \mp 3\cdot 7c_2/z^2)
\end{aligned}\right\}\ \ldots\ (6)$$

In the above I have more or less quoted the results recently obtained, which are all claimed to be new.

Full details of the investigations will be published elsewhere.

M. GHOSH.

Physical Research Laboratory,
Presidency College,
Calcutta,
*August, 1933.*

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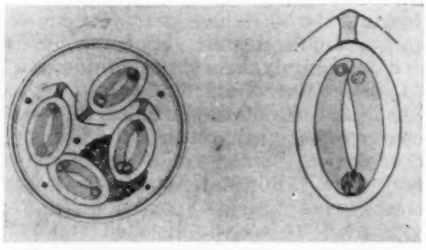
## Fish Coccidia.

Two unique types of Eimera, hitherto not recorded, were found during investigation on Coccidia by Miss R. H. Bana, a student preparing under me for the M.Sc. degree. She has also discovered and worked out the complete life-cycle of a new species of Isospora from Calotes versicolor. A brief résumé of the main features of each is given below.

One of the Eimera referred to above and hitherto not recorded, was found in the alimentary canal of a fish popularly known as Bombay Duck (*Harpodon nehereus*) *vide* illustration. Each sporocyst in this species is elliptical in outline with the end towards the narrow side of the oval projecting in the form of a neck. At the edge of this protuberance or neck is a broad inverted V-shaped appendage which is clearly visible both in the living and stained preparations. A sporocystic residue is also usually present. The oocysts are often almost spherical and have a diameter of about 12$\mu$.



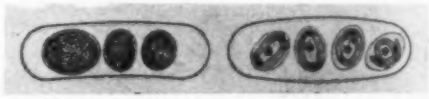
Oocyst and Sporocysts from *Harpodon nehereus.*

### Reptilian Coccidia.

(A) EIMERA FROM HEMIDACTYLUS SP.

The host is usually obtained on exterior walls of buildings. It is probably *Hemidactylus flaviviridis*. The parasite which was found in the gall bladder is undoubtedly a species of Eimera. So far Eimera have usually been met with in the intestine, liver and kidney of their hosts. The present find is therefore unique despite the only species of Eimera (*E. utinensis*) in the lungs and gall bladder of a horse in Italy by Salen and Vittoria (1924). Of their discovery Wenyon (1926) says that the description and figures are so unsatisfactory that it is impossible to form an opinion of the nature of the structures depicted.

The uniqueness of the present find lies in that all the developmental stages are completed in the columnar cells of the gall bladder. The ripe oocysts measure 24$\mu$ by 34$\mu$ in length and 11$\mu$ by 14$\mu$ in breadth. The sporocysts measure 9$\mu$ by 7$\mu$.



Eimera from *H. flaviviridis.*

(B) ISOSPORA SP. FROM CALOTES VERSICOLOR.

A new species of Isospora, which infects the intestine of the lizard, has been found. The complete life-cycle of the parasite has been worked out.

The developmental stages of the parasite are very simple and in many respects follow those of *Isospora felis* (Wenyon). Their chief interest lies in the apparent clearness of their developmental stages and the intensity of infection, the number of infected lizards being as large as 80 per cent. The importance of this find lies in the abundant facilities such Isospora provide for class work, as calotes are freely distributed all over the country.

A critical study of the parasite has been made and the detailed results of the investigation will be duly published.

S. B. SETNA.

Royal Institute of Science,
Bombay,
*August 28, 1933.*

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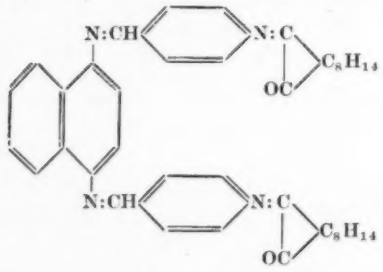
## Bisiminocamphor Derivatives with Exalted Optical Activity.

FORSTER and Thornley (*J. C. S.*, **95**, 942, 1909) observed that bisiminocamphor derivatives display remarkably high rotatory power, and this was later ascribed to an optimum association of azethenoid groups, conjugated linkages and a benzene ring within a narrow molecular compass (Forster and Spinner, *ibid.*, **115**, 889, 1919). B. K. Singh and his collaborators have prepared

1 : 4-naphthylenebisiminocamphor and *pp'*-bisiminocamphordiphenylamine, with molecular rotations 13416° (pyridine) and 14231° (ethyl alcohol), respectively. These two compounds were known so far to possess the highest molecular rotation. We have now prepared 1 : 4-naphthylenebisiminobenzyl-




ideneiminocamphor, in which the number of conjugated double linkages has been increased to seventeen; and the molecular rotation reaches 22050° in pyridine for the mercury yellow line, 5780. This compound has been obtained by condensing *p*-acetaminobenzaldehyde with 1 : 4-naphthylenediamine, removing the acetyl groups by dilute hydrochloric acid in alcohol, and condensing the resulting bisaminobenzylidenenaphthylenediamine with camphorquinone

The bisiminocamphor derivatives of *pp*-diaminodiphenylcarbamide and *pp*-diaminodiphenyloxamide show molecular rotations 8911° and 12094° respectively in chloroform.

P. C. GUHA.
S. M. PATEL.

Indian Institute of Science,
Bangalore,
*August 28, 1933.*

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## Physiology of the Stink-glands of the Millipede, *Thyropygus malayus*.

THE stink-glands or the *Glandulæ odoriferæ* are of common occurrence in millipedes. The work that has been done on the physiology of these glands is summarised in Kukenthal's *Handbuch der Zoologie*, Band IV (1926-28). The chief substances of physiological interest in the secretion of these glands mentioned are Prussic acid, Iodine and Quinine. The presence of *Chlorine* is so far unknown in these glands but I have been able to demonstrate its occurrence now in the secretion of the stink-glands of *Thyropygus malayus*.

The main facts as studied in *Thyropygus malayus* are as follows:—

The glands are situated on the lateral walls of the chitinous body rings as sac-like structures consisting of a bladder-like vesicle and a protruding tubular channel with a regulating lid near its opening. The glands open to the exterior by longitudinal slits, the *Foramina repugnatoria*. The first seventeen pairs of glands are small and have smaller openings but those situated behind are comparatively bigger and have larger openings as well. The glands are, however, absent from the first five segments of the body including the Collum, as well as from the last or anal segment. A yellowish, pungent fluid constantly oozes out of the *Foramina repugnatoria*, but when irritated the millipedes pour out considerable quantities of this offensive secretion. Each gland has got its own blood and nerve supply.

The yellow and oily secretion of the glands is readily miscible with water imparting a yellow colour to the solution which on standing turns brown. When dried the secretion forms dark black shining flakes. The odour of the secretion is very pungent with a faint smell of bitter almonds, which becomes very characteristic when the solution stands for some time. This pungent odour according to my experimental evidence, is due to *Chlorine* which mars the smell of bitter almonds due to Hydrocyanic acid which latter only becomes prominent after the *Chlorine* has volatilised.

The quantities of the chemical substances present in the secretion being very small, microchemical tests were applied in the experiments. For this work, fresh gland extracts were prepared by pounding 200 glands with 10 c.c. of distilled water and concentrating on a waterbath (temperature maintained below 40°C). A blank test was applied in each case for comparison.

1. Gland extract treated with Ferrous sulphate and Sodium hydroxide and evaporated on a waterbath. With the addition of a little dilute Hydrochloric acid and a drop of Ferric chloride, a greenish blue colouration was detected under the microscope.

2. Gland extract treated with yellow Ammonium sulphide and evaporated to dryness. Acidified the residue with a little

dilute Hydrochloric acid. The addition of a drop of weak Ferric chloride gave a characteristic scarlet red colour.

These experiments show clearly the presence of Cyanide in the secretion. Volumetric tests were tried by taking various strengths of Potassium cyanide solution and titrating with Copper sulphate solution. Most favourable results were obtained with 1/1800 N/10 Potassium cyanide solution when compared with the gland extract titrated in the same way. The strength of Cyanide in the glands is, therefore, approximately 1/1800 N/10.

3. Secretion obtained from the glands was treated on a slide with a drop of distilled water, a drop of weak solution of Potassium iodide and a drop of ·5 per cent fresh starch solution. Evaporated on waterbath to a paste. Examination under microscope revealed light blue stained starch grains.

4. Two more experiments were conducted on similar lines one without the addition of the gland secretion, the other by taking a few drops of Chlorine-water instead of gland secretion. In the former starch grains remained unstained, but in the latter case the results were greatly marked as the starch grains were stained deep blue.

All these experiments clearly demonstrate the presence of *Chlorine* which owing to minute quantity could not be otherwise detected.

We may, therefore, conclude that *Chlorine* is an important ingredient of the gland secretion. The presence of Chlorine together with Hydrocyanic acid makes the animal unpalatable and the disinfecting properties of the substances help in keeping the surrounding soil where the animal lives free from bacteria and other micro-organisms.

A detailed account of the structure and physiology of these glands will be published shortly.

M. B. LAL.

Department of Zoology,
The University, Lucknow,
*August 1933.*

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## The Life-History of *Liminophyton obtusifolium* Miq.

THE embryo sac of the ALISMACEÆ has been a morphological puzzle. A single species *Alisma plantago* has been investigated by no less than five competent workers—Ward (1880), Fischer (1886), Schaffner (1896), Nitzschke (1914), and Dahlgren[1] (1927), and the accounts of all the five authors are different even in essential respects from one another. The last-named author has studied three other genera of the family and finds that the embryo sac development in all the four is of the "Scilla-type" and there are only 6, rarely 5 nuclei in the embryo sac. He holds that the previous accounts on the embryo sac of *Alisma plantago* were incorrect.

In April 1932, I started some work on the life-history of *Limnophyton obtusifolium* and an abstract of the results obtained was published in *Current Science* (Vol. 2, p. 12). In the last number of the same Journal (Vol. 2, p. 53), Mr. S. K. Narasimha Murthi records some observations which are in some respects very different from those obtained by me. With a view to find out the source of the discrepancy, a fresh study was made of some of the stages and the points of difference are dealt with here.

MALE GAMETOPHYTE.—After the differentiation of the four groups of archesporial cells in the anther, the outer cells divide periclinally and cut off a primary parietal layer which gives rise to the endothecium, a middle layer and the tapetum. The middle layer is ephemeral and is soon absorbed. I am unable to think of any explanation of its reported absence in the material studied by Mr. Narasimha Murthi. At the time of tetrad formation the tapetal cells begin to protrude inwards and "wander" inside the loculus. For some time they preserve their identity, but later they meet irregularly and a true periplasmodium *is* formed, which begins to degenerate after the laying down of the exine in the pollen grains. Too much emphasis need not, however, be placed on the terms "true" and "false" periplasmodium, as defined by Tischler, for as Schnarf[2] points out these are all gradations between the two.

Since my previous note appeared, I have been able to find out pollen grains with male *cells* as described by Mr. Narasimha Murthi, but their presence is not a constant feature. As figured by me in my last note, there are many pollen grains in which there is not the slightest trace of a

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[1] Dahlgren, K. V. O., "Die Embryologie Einiger Alismataceen," *Svensk Bot. Tidskrift.*, **22**, 1–17, 1928. (The other four works are quoted in this paper.)

[2] Schnarf, K., *Embryologie der Angiospermen*, Berlin, 1927, p. 34.

difference between the general cytoplasm of the grains and that surrounding the male nuclei.

FEMALE GAMETOPHYTE.—Apparently my account entirely agrees with that of Mr. Narasimha Murthi upto the four-nucleate stage. He writes that all four of these divide and the normal 8 nuclei are formed, while I have hitherto maintained that there are only 6. In order to explain the difference Mr. Narasimha Murthi suggests that this may be due to my having examined only later stages when two of the nuclei at the antipodal end had already degenerated.

To meet this objection I am giving here the results of a statistical study made from a recent examination of 100 embryo sacs, in 90 of which egg-apparatus had not yet fully organized, though the synergids had begun to be differentiated. There were three conditions:—

1. The two chalazal nuclei do not divide at all, embryo sacs six-nucleate. This was found in **80** cases.

2. Only one of the chalazal nuclei divides, embryo sacs seven-nucleate. This was found in **15** cases.

3. Both of the chalazal nuclei divide, embryo sacs eight-nucleate This was found in **5** cases.

The results speak for themselves.

I feel convinced that there is a considerable variation in the embryo sacs of this plant and this may also explain, at least to a large extent, the different observations made by Schaffner, Nitzschke and Dahlgren on the embryo sac of *Alisma plantago*. The prevailing condition, however, is the six-nucleate one, as brought out in my last paper, and as found by Dahlgren in *Alisma plantago*, *Elisma natans*, *Echinodorus ranunculoides* and *Damasonium alisma*.

EMBRYO.—Mr. Narasimha Murthi finds that a longitudinal wall is laid down in the terminal cell after the proembryo is five-celled, but I find that this may occur even at the four-celled stage and occasionally it may be delayed to the six-celled stage. The other observations on the embryogeny are in agreement with those made by me.

I am indebted to Dr. P. Maheshwari for his kind help and suggestions. Some slides illustrating the life-history of the plant were also sent to Dr. K. V. O. Dahlgren of Uppsala who entirely confirmed the observations made by me regarding the six-nucleate nature of the embryo sac.

BRIJ MOHAN JOHRI.

Department of Botany,
Agra College, Agra,
*August 28, 1933.*

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## Somatic Chromosomes and Microsporogenesis in Cobra or Snake Lily, *Arisæma murrayi* (*Araceæ*).

VERY young plants of Cobra Lily begin to appear in large numbers in Mahabaleshwar, Western Ghats, Bombay Presidency, from about the beginning of the fourth week of May. Cytological observations show that in order to obtain for study all the stages in microsporogenesis it is necessary to fix very young stages of spadix from the plants which are almost underground, or which are still enclosed and whose tops only have just appeared above the subsoil.

The chromosomes are fairly large and the diploid number as seen in root tips is 28. Equatorial plates of the somatic chromosomes at the metaphase are more commonly found in the peripheral region of the root tip. But the most interesting feature is the behaviour of the nucleus in the course of pollen formation. In almost diagrammatic clearness and in an unmistakeable sequence are presented all the various stages through which the nucleus of the pollen-mother-cell passes in its growth and development. And this may well serve as a good example in demonstrating a straightforward microsporogenesis to students of advanced classes. Regarding synizesis one finds it difficult to believe that it is merely an artefact when it presents the same aspect, a closely tangled mass of deeply stained chromatin threads engulfing the nucleolus and lying on one side of the nucleus adjacent to the nuclear membrane, under a variety of fixatives. For a considerable period of time during diakinesis bivalent chromosomes stand well apart from one another in a seemingly clear space bounded by a remarkable clear nuclear membrane, which persist long after the bivalents have undergone considerable condensation and shortening.

Fourteen bivalents in the equatorial plate form the haploid number of chromosomes in the heterotypic division. These have been counted in a large number of heterotypic metaphases and anaphases, and in an equally large number of the same phases

in homeotypic division. As the daughter nuclei are reconstructed distinct membranes or partitions appear in the equatorial regions of the spindles. And in this connection it may be remarked that during the quadripartite division of the parent cell leading to the formation of the pollen furrowing in the cell wall of the pollen-mother-cell is not in evidence.

A detailed account of the behaviour of the nucleus and its divisions studied will be presented in the near future.

J. J. ASANA.

Ismail College,
Andheri, Bombay, S. D.,
*August, 1933.*

## Aligarh New Science College.

By Muhammad Zakiuddin, M.Sc. (Alig.),
*Research Scholar, Aligarh.*

THE long-expected Science College of Aligarh is now completed due to the painstaking efforts of Nawab Masood Jung Dr. S. R. Masood, the Vice-Chancellor of the Aligarh University.

The erection of the new laboratories in Aligarh has created a new era not only in the History of Aligarh, but the whole of India. Up-to-date Laboratories fitted with modern appliances for Research and Advanced Studies and teaching and practical work, have been installed in separate blocks containing enough accommodation. Each of these blocks are fitted with D.C. and A.C. supply, coal-gas, etc., and arrangements for ventilation and light have been properly made. To each of these Departments is attached a Library containing all the important Journals and Books of Science in English and other European languages.

### DEPARTMENT OF PHYSICS.

The Department of Physics extending over two buildings—one for the Research and Advanced Studies and the other for practical and teaching work—containing about seventy rooms,—is under Prof. Dr. R. Samuel, PH.D. (Gottingen), Nizam Professor of Physics in the University. Dr. H. Lessheim, PH.D., a well-known Mathematical Physicist of Germany, has been appointed recently to teach Mathematical Physics and Applied Mathematics. Dr. R. K. Asundi, B.A., M.SC., PH.D. (Lond.), the discoverer of the well-known "Asundi Bands," is the Reader in Physics.

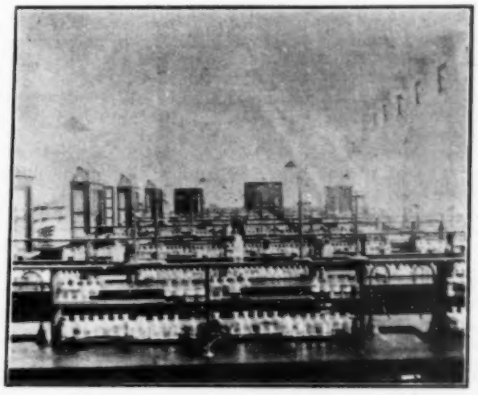
At present there are about 18 research workers in the department working on various problems of Spectroscopy. The Laboratory has been equipped with apparatus for the study of all the regions of Spectra from the Infra-red to the Extreme Ultra-violet and Soft X-Rays. The problems undertaken vary from the study of the Absorption Spectra of liquids, solutions, and vapours in the whole of the Spectroscopic Region, Electronic Impact, Electronic Diffraction, Photochemical Reaction and Band spectra. Apparatus like Zeiss Photometer, Zeiss Abbe Comparator, Two Vacuum Spectrographs, Soft X-Ray Spectrograph, Leiss E, Quartz Spectrograph, Zeiss Three Prisms Glass Spectrograph, 10 and 21 feet Grating and Infra-red Spectrograph and other apparatus have been installed.

### DEPARTMENT OF CHEMISTRY.

Prof. R. F. Hunter, A.R.C.S., D.I.C., A.I.C., M.SC., PH.D., D.SC. (Lond.), Nizam Professor of Chemistry in the University, is the Director of the Chemical Laboratories. He is assisted by Dr. R. D. Desai, B.A., D.I.C., M.SC., A.I.I.SC., D.SC. (Lond.), and Lt. M. Haider Khan, B.SC. (Alig.), B.SC. (Lond.), M.A. (Cantab.).

Prof. Hunter and his students are working on various problems ranging from the study of Tautomerism, Electronic Mobility, Analysis of Organic compounds, to finding out Dipole moment and Absorption spectra of these compounds.

There are about ten research workers, working under Prof. Hunter.



### DEPARTMENT OF CHEMISTRY.

The Botanical Laboratories are under Dr. R. A. Khan, M.SC., PH.D. (Cantab.), who has recently returned from Cambridge. He is assisted by Dr. A. A. Hyder, B.A., PH.D. (Gottingen).

The Department has been equipped with all the apparatus required for the study of the Physiological aspects of Botany.

A Botanical garden is attached to the department for growing all the necessary plants and herbs required. At present only three men are working in the department, but it is expected that very soon the number will increase. Special care has been taken to equip the Botanical Museum with the necessary specimens.

DEPARTMENT OF ZOOLOGY.

The Zoological Laboratories are under Dr. M. B. Mirza, D.Phil.Nat., who is assisted by Dr. M. A. Sharif, M.A., D.Sc.

The Zoological Museum has been equipped with all the necessary specimens required for teaching and demonstration. At present there are four research students working in the department on various problems of Entomology and Advanced Zoology.

Recently the Department of Zoology sent a party to the various parts of India to gather fossils and other specimens and the members of the party returned with success bringing a large number of rare specimens.

The plans for the Medical College, College of Technology, Agricultural College, Electrotechnical Department and Engineering College have been completed, and it is hoped that within a few years the big University Extension schemes will be complete.

Aligarh in the past sixty years has been well known as one of the greatest educational centres not only in India, but the whole of Asia, where students have flocked from different parts without the *distinction of colour, caste or creed*, and have imbibed from the fountain of learning so wisely created by the late Sir Syed Ahmed Khan, to whom India is so highly indebted.

## Crystals of the Living Body.*

IN the living body, there is a preferential distribution of the various kinds of atoms as for example phosphorus and calcium in bones and teeth, and sulphur and nitrogen in hair. Besides this differentiation, there is a greater one of the molecules into which the atoms are grouped, thus, the several kinds of proteins function differently as constituents of the many organs of the body. A further requisite is order in the arrangement of the molecules. To cite an instance, in hair, the long narrow arrangements of molecules fastened somewhat loosely like bundles, endows it with the property of directive action. This direction is nearly the same as that of the axis of the hair so that it grows in a particular direction and is flexible and strong. If the molecules were distributed in all directions, there is no reason why hair should possess these properties. All processes in the living body follow the laws of physics and chemistry and consequently, function which is connected with orientation means method in molecular arrangements. No artificial arrangements of atoms and molecules has ever been endowed with life nor can an indiscriminate one extend and grow in one direction more than in another. All the parts of the body such as nerves, muscles and tendons possess arrangements which are fitted for their purpose not only by shapes but also by the internal arrangement of their molecules. Hence it is very essential to understand the arrangement of molecules in the living body if we are to understand their functions properly.

Chemical analysis tells us very little of this arrangement. We are only aware of the bricks of the house with very little knowledge of the exact plan of the home of which they form parts. The arrangements of atoms in molecules have come in for wide study by the organic chemists but the relative arrangement of the materials with reference to one another is also of great import. Especially is this so of solids where directive properties come into play. In this study, the X-ray has proved an extremely useful weapon.

The study of solid crystals suggests itself readily because the crystalline form is the result of the molecular arrangement. Thus the properties of crystals of zinc blende on heating and those of resorcinol when suspended in liquid air are exactly those that can be expected in a molecule of the type studied and the X-ray pattern reveals the same characteristics but whatever is true of the whole is true of the unit imbedded in it. It does not mean that the individual unit will behave in this way if taken out of its environment.

This is an important point. The study of a crystal furnishes information regarding a small group of molecules say one, two, three or four. If we determine the arrangement of molecules in this group and of the atoms in the molecule, we can correlate properties and arrangements and thus contribute to one of the greatest problems of physics, namely, the relation between the properties of a substance and the atoms of which it is built. Conversely, using the knowledge, we can apply it to other units by the examination of crystals of which these units form parts. So the position of the various atoms in the molecule determines the characteristics of the molecule; the position of the molecules in a solid determines its crystalline form. In a living body there must be arrangements of molecules of various kinds to various extents. X-ray patterns help us to understand these arrangements.

X-ray studies have generally confirmed the conclusions of the organic chemists and have also further extended their knowledge to greater completion. Thus two amino acids like glycine and alanine each possessing a carboxyl and an amino group of opposite character can condense together with the elimination of water. Willstätter supposed that such combinations can take place in regular alternations yielding chains of indefinite length. Now silk on hydrolysis gives both alanine and glycine. If this regular structure is the cause of the X-ray photograph of silk, the numerical details of the photograph should fit into the chemist's conception. From X-ray studies of various crystals we know that the distance along the chain at which the pattern (two carbons and one nitrogen) repeats itself should be 3·6 A°. Although the X-ray pattern gives a very hazy picture of the position, measurement shows a regular repetition of pattern at a distance of 3·5 A° which is a remarkable coincidence with the calculated value. The X-ray photographs also show that the chains are arranged in a row

* "Crystals of the Living Body"—Friday evening discourse delivered by Sir William Bragg, O.M., K.B.E., F.R.S., at the Royal Institute, January 20, *Nature*, **132**, 11 and 50, 1933.

parallel to the direction of the fibre—an arrangement that we ought to expect.

It is well known that the hair stretches and photographs in a manner resembling that of silk though its chemical structure is similar to those of horn and feathers. Astbury explained this phenomenon by supposing that the chain which forms the backbone of all the proteins is similar to silk. In the keratins they are crumpled up somewhat; tension pulls them straight without breaking them and on release, the contractile forces draw them again together. But beyond the breaking point, the molecules slip past one another and so cannot be restored to their original state. These suppositions are practically demonstrated by X-ray photograph which, for example, in wool, shows repetition at intervals a little less than silk, whereas in hair it is 30 per cent. less; and hair recovers completely after 30 per cent. of extension.

The same hypothesis gives an explanation of the resistance of these substances to enzyme attack, for the crumpled chain protects the molecule from breakage. The compactness masks susceptible points and this is helped by the mutual satisfaction of opposite groups. This only illustrates that not only do the molecules of a chain determine its character but the arrangements of the molecules themselves decide the behaviour of the substance. Arrangements of the protein molecules among themselves are essential to their function in the living body.

These are but the beginnings of future interesting revelations that will follow more precise measurements. The X-ray is a new tool and needs wider application in more cases before it can be properly used and its full capacities understood.

A most interesting example is the examination by J. D. Bernal and his colleagues of the crystal structure of the separate amino acids, vitamins and similar bodies. When such bodies can be crystallised, valuable knowledge of the arrangement of atoms and molecules can be studied. Chemical considerations suggest many possible arrangements which X-ray studies narrow down. Thus Bernal showed the former formula for sterol to be incorrect and later search has been successful in proving his point. Bernal's results indicate the possibility of studying the changes as the configuration is altered step by step, and the comparison of the gradually changing quality with corresponding changes in certain dimensions gives important hints about the constitution of the substance. The optical, magnetic and other constants of a crystal show remarkable dependencies in the form and now we are able to determine the contents of the unit of pattern and sometimes go as far as to find the position of atoms and molecules in the unit: the constants can then be connected directly with the contents of the unit. Another method of arriving at the same direction is to work out the arrangement of atoms in simple crystals to completion. The laborious task cannot at present be applied to complicated cases. The effect of relative positions of various groups can be worked out and the knowledge thus obtained applied to other cases.

Several investigations have been recently done along these lines. One of the results obtained is a better understanding of the details of linkages between carbon atoms. We speak of the single bonds and double bonds. There are two linkages, the close diamond linkage and the wider graphite linkage. X-ray studies show differences between the two linkages that is beyond experimental error. The former is found in fatty acid chains and similar compounds where each carbon atom has four neighbours, two carbon and two hydrogens. The latter occurs in naphthalene and anthracene, the basis of which is the benzene ring; in these carbon has three neighbours as in graphite. It may prove to be the case that the former kind of bond is peculiar to aromatic substances and the latter to the aliphatic. The heats of combustion of diamond and graphite are very nearly the same: so that it takes as much energy to break down the four bonds in the diamond as the three in the graphite. In such a comparison the heat spent on breaking the weak bonds between the network layers of graphite is taken to be negligible.

Such accurate measurements as these encourage the hope that there are exact rules as to distances apart of the atoms, and very probably as to their mutual orientation. Knowledge of these rules will greatly facilitate the determination of structure.

## Research Notes.

### The Physiological Anatomy of *Ulex europæus* L.

IN a paper published by T. S. Raghavan in the *Journal of the Annamalai University* (**1**, No. 2) the results of an investigation into the anatomy of the vegetative organs and its probable bearing on xeromorphy are set forth. A parenchyma sheath in close contact with the vascular region is identified as a modification of Haberlandt's second system of construction of photosynthetic cells. How far this plant could be regarded as xerophilous is discussed. Increased assimilative surface by ridges and furrows and consequent high stomatal frequency, a well-developed conducting tissue, and the dissected nature of the leaves which besides being resistant to strong winds, also being a means to reduce the distance between the water conducting veins and the evaporating cells of the mesophyll—all these indicate that ulex cannot be termed xerophilous but only drought resistant.

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### Observations on the Stomatal Distribution and the Rates of Transpiration in Wilting Leaves.

STOMATAL distribution and the rates of water lost by wilting leaves of a dozen plants comprising mesophytes, halophytes, and succulent xerophyte have been investigated by T. S. Raghavan (*J. A. U.*, **2**, No. 1). Stomatal frequency as well as rates of transpiration in the halophytes are high and therefore they cannot be termed xerophilous. How far the loss of water in wilting leaves is a purely physical phenomenon is discussed. No direct relationship exists between the rate of transpiration and the number of stomata per unit area. Till about three hours after severance from the plant, the leaves exhibit fluctuations in the rates of water loss. The water content of the leaf cells seems to control the rate of transpiration. It is believed that wilting leaves behave like ordinary leaves till a certain time in respect of transpiration. On the water deficit reaching the maximum, the time taken for which varies with different plants, there is only a uniform decline in the rate and no more rises and falls occur.

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### Development of *Ophiocoma nigra*.

IN this paper (*Q. J. M. Sc.*, **76**, part I) Dr. N. Narasimha Murti gives a complete account of the development and metamorphosis of an Ophiuroid. That a 'right hydrocœle' arises as a thickening of the right anterior cœlom in most larvæ in addition to the usual left hydrocœle and that it degenerates as metamorphosis progresses are two points of interest. The author also observes that a 'pericardial vesicle' originates from the right anterior cœlom in the same manner as in the sea-urchin and the star-fish and that it persists in the adult as a thin walled pulsating sac. Another observation to note is that the most posterior lobe of the left hydrocœle does not move across the œsophagus towards the larval right but bends to the right to meet the most anterior lobe which travels towards it after passing round the œsophagus. The author has further shown that all the 'perihæmal spaces' arise as pocket-shaped evaginations from some part of the left posterior cœlom or other, recalling the similar state of affairs in the star-fish Asterias. Yet another remarkable feature of the late larval forms of Ophiocoma is that the outer ends of the cylindrical cells of the stomach are vacuolated and stain deep black in specimens preserved in osmic acid followed by Muller's fluid — owing probably to the presence of fat in them. The fact that in the just metamorphosed larvæ the stomach appears, at first, as a solid mass and later sends out five projections alternating with the arms seems to be a new observation. The work, in short, attempts to verify the results of previous authors and to add new observations wherever possible.

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### On the Occurrence of Hepato-Pancreatic Glands in the Indian Earthworms of the genus *Eutyphœus* Mich.

IN this important paper, [K. N. Bahl and M. B. Lal, *Q. J. M. S.*, **76**, pp. 107—127, pls. ix and x, June, 1933.] Prof. K. N. Bahl of the University of Lucknow has described the structure, development and blood-supply of the "intestinal glands" which occur as paired structures on the dorsal surface of the gut of earthworms of the genus *Eutyphœus* in segments 79 to 83. As the glands in each segment are fused in

the middle line and those of successive segments are connected, it has been rightly stated that it would be just as correct to speak of a single large gland extending over *five* segments. The glands are richly supplied with blood-capillaries and open into the intestine through ciliated apertures. In the physiological part of the work, in which Dr. Bahl, as is indicated in the introductory chapter, was assisted by his demonstrator Mr. M. B. Lal, interesting experimental evidence is adduced in regard to the nature and function of these glands. That the glands do not secrete calcium but a proteolytic ferment is amply proved by digestion-experiments; that their blood-supply resembles a hepatic portal system is brought out convincingly in the illustrations of both sections and dissections; that glycogen-granules are present in the cells has been demonstrated by staining sections with Best's carmine; and, finally, that they develop as mid-dorsal outgrowths of the endodermal lining of the gut has been worked out in embryos. In view of all these characteristic attributes, the glands are presumed by the authors to be hepato-pancreatic in nature and this view is fully confirmed by the situation of the glands—they lie just at the place where the main work of digestion and absorption takes place. The paper is beautifully illustrated and marks a great advance on our knowledge of the morphology and physiology of the oligochæta.

B. P.

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### Fire Hazards in the Use of Oxidising Agents as Herbicides.

IT is not often realised that certain chemicals, particularly chlorates and dichromates, are not safe to use as herbicides, particularly under conditions where the relative humidity of the atmosphere is likely to fall below 30 or 40 per cent. In his recent publication of the subject (*Canadian Journal of Research*, **8**, 509, 1933) Cook has drawn attention to the nature of hazards attendant on the use of various herbicides both by themselves and in association with other chemicals. The chlorates are generally hazardous by themselves but when mixed with chlorides, particularly those of magnesium or calcium, in equal proportions, they are generally very safe to handle at all the usual concentrations. The most effective mixture would be that containing two-thirds of sodium chlorate and one-third of magnesium chloride. It has a herbicidal power equivalent to about half that of pure sodium chlorate.

It is hoped that the above observations would be of interest to those engaged on the eradication of noxious weeds, particularly in the midst of other forms of vegetation, as in forests or in the neighbourhood of human habitations.

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### Stabilisation of Chlorinated Hydrocarbons.

ALTHOUGH chlorinated hydrocarbons have lately found much favour as solvents for a variety of substances, yet their instability, as also their tendency to attack metallic containers, have always been a source of trouble to their users. The Imperial Chemical Industries have recently developed a process for the stabilisation of such compounds (*Ind. Pat.*, No. 19646, 1933) which involves the addition of alkylamines the boiling points of which are not substantially different from those of the chlorinated hydrocarbons concerned. The stabilising action of the alkylamines is further augmented by the addition of small amounts of alkalies or alkaline reacting compounds, which, under the working conditions, are capable of liberating the alkylamine from its hydrochloride and which are inert to the chlorinated hydrocarbon. This invention should render chlorinated hydrocarbons still more popular than before.

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### An Improved Process for preparing Vegetable Fibre Rubber Product.

Two French Engineers have developed a process (*Indian Paten*, No. 19498, 1932) for the combination of mercerisation with impregnation with rubber. When treated with the mercerising agent the vegetable fibre swells up. It is then washed free from caustic alkali and then pressed with finely dispersed rubber, which may be natural or synthetic, vulcanised or otherwise. The product thus obtained is a compact and homogeneous mass of vegetable fibre and rubber which is useful for a variety of purposes, particularly for making felted materials and in the pneumatic tyre industry. It is not unlikely that these and related products will soon play an important part in the development of a number of products which combine the good qualities of both cellulose and rubber.

### Embryonic History of the Germ Cells in *Passer domesticus* (L).

IN this important contribution Hubert W. Blocker (*Acta Zoologica*, Bd. XIV, 1933, five plates and 32 figs.) has given an account of the breeding habits of the bird and confirmed the results of Etyold and Loisel concerning the seasonal variation in the testes of sparrows. In his critical study the investigator has not only given the characteristics of germ cells but also reviewed morphological and experimental studies on the early history of germ cells. The author summarises and concludes his elaborate study of the very vexed question of the origin of germ cells as follows: The primordial germ cells of *Passer domesticus* are of extra-embryonic origin and are first seen in an embryo of one or two somites in a crescent-shaped area at the outer margin of the proamnion. They are found in the ectoderm and in spaces between the ectoderm and endoderm. They remain in this position up to seven or eight somite stage during which time they take on more definite germ cell characteristics. After the arrival of the mesoderm, the germ cells enter the vessels of the vascular area, in part passively during the formation of the blood islands and in part actively by forcing through the endothelial lining of these vessels. In a ten-somite embryo all stages in the process of migration can be observed. The germ cells are carried through the circulation with the blood cells and at about twenty-five somite stage make their appearance in the small vessels of the splanchnopleure where they leave their vessels and begin their migration toward the site of the future gonad, where some of the germ cells take their place among the cells of the so-called germinal epithelium. The lodging of the germ cells in the vessels of the splanchnopleure is attributed solely to mechanical factors, and is dependent on the size and shape of the vessels in this region. The progress of migration of the germ cells from the vessels of the splanchnopleure continues to about thirty-six somite stage, when practically all the germ cells have left the blood vessels. A small number of germ cells become lodged in small vessels of distant regions and never reach the gonads.

There is a shifting of the germinal epithelium with its contained germ cells from the splanchnopleure through the coelomic angle to the somatopleure during the stages from three to four days incubation. During the formation of the gonads and during sex differentiation germ cells are found in all parts of the gonad. The first mitoses of germ cells were observed in a four and one half day embryo. During sex differentiation there is no distinct formation of tubules as has been described for the chick. The first reliable criterion of sex distinction is the relative size of the right and left gonad in the female. A rudiment of the right gonad of the female with the germ cells persists at all stages of incubation. It retains its undifferentiated structure throughout this period. Histologically sex cannot be distinguished before the eighth day of incubation when a cortex begins to form beneath the epithelium of the left ovary. The primordial germ cells are not replaced by a second generation of germ cells but they give rise directly to the definitive sex elements. Their number is increased only by mitosis and no germ cells are derived from somatic sources.

A. S. RAU.

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### *Crocuta pilgrimina*, N. Rao—A New Fossil Hyæna.

A NEW species of fossil hyæna, derived from sorely denuded surface deposits overlying the Ariyalur Cretaceous beds of Trichinopoly district, named *Crocuta pilgrimina*, N. Rao, has been described by Prof. C. R. Narayan Rao in the *Half-Yearly Journal of the Mysore University*. The new species makes an interesting addition to the known fossil Hyænæ described by Pilgrim from the Upper Tertiaries and post-Tertiary of various parts of India. The precise affinities of the present fossil with the latter are described by the author. The genus *Crocuta* is now totally extinct from South India, though a solitary species *C. crocuta* is still found living in Africa. The exact horizon of the fossil is a little doubtful, varying from Upper Cuddalore sandstone stage to the Pleistocene. It is hoped that some associated ungulate and carnivore remains obtained from the same locality may solve the question of the age of the Ariyalur mammaliferous beds.

D. N. W.

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### The Endocrine Factors concerned in the Control of the Ovarian Cycle in *Xenopus lævis*.

THE influence of pituitary extracts on the activity of the ovary in mammals has been

extensively studied, but C. W. Bellerby (*Biochem. Journ.*, **27**, No. 3, 1933) has used *Xenopus lævis* as a test animal with great advantage. The employment of this animal for the experiments has obviated the necessity of killing the animal to examine the condition of the ovary, as the extrusion of the eggs marks the activity of the ovary. Even under normal conditions ovulation in *Xenopus* does not take place in the laboratory so that the extrusion of the eggs after injection of the extract is full of significance. A further aid is afforded by the fact that ova extruded after pituitary injection are devoid of the mucilaginous envelope so characteristic of the Amphibian egg shed in the normal manner. It has been found that ovarian activity can be induced in *Xenopus lævis* even outside the breeding season in the laboratory. In all cases both acid and alkaline extract injections of the ox anterior pituitary were made and the effects of these two are identical in producing ovulation. It is seen that while there is no relation between the number of eggs shed and the dosage, the relation between the percentage response and dosage is evident. In fact this relation is more constant in *Xenopus* than in mammals. And on account of the absence of the necessity of killing the animals, the same set of animals may be used successively for a series of experiments. Ovulation usually occurs within 18 hours after injection, rarely over 48 hours.

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### The Component Fatty Acids and Glycerides of the Milk Fats of Indian Goats and Sheep.

D. R. DHINGRA (*Biochem. Journ.*, **27**, No. 3, 1933) has extended the work of Hilditch and his co-workers on the fatty acids and glycerides of Indian cows and buffaloes. The author gives a comparative account of the properties of the milk fats of goats and sheep and those of cows and buffaloes and comes to certain interesting conclusions. The goats and sheep which formed the source of the milk fats in this investigation came from two different localities in the Punjab separated by a distance of about 300 miles but fed on the same diet in the same winter season. As compared with the cow and buffalo butter fats the Polenske value of the goat and sheep butter fats is higher while the Kirschner values in relation to the Reichert-Meissel values as also the saponification equivalents are low. Another point of special mention is the higher content of capric, caprylic and caproic acids in the goat and sheep butter fats. This seems to be almost exclusively at the expense of oleic acid. There is, on the whole, a similarity between the properties of the goat and sheep fats and the cow and buffalo fats.

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### On the Nature of the "Yolk Nucleus" of Spiders.

SUKH DYAL AND VISHWA NATH (*Journ. Roy. Micros. Soc.*, Ser, III, **53**, Part 2, 1933) have come to the conclusion that the albuminous yolk at the periphery of the egg in spiders is not traceable to the mitochondria, the golgi elements or the yolk nucleus and is probably *de novo* in origin. The yolk nucleus of *Plexippus paykulli* is of the same type as described by Wittich. The yolk nucleus of *Plexippus* is differentiated into a cortex and a medulla, the mitochondria being prominent in the former and the golgi elements in the latter, while the "substance specifique" secreted by the golgi in the yolk nucleus of *Tegenaria* described by Weiner is absent.

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## Science News.

The Twenty-first Annual Meeting of the Indian Science Congress will be held in Poona from January 2nd to 7th, 1934. Dr. Meghnad Saha, D.Sc., F.R.S., F.A.S.B., Professor of Physics, Allahabad University, Allahabad, will be President. Intending members are requested to send their subscriptions, preferably before the 1st October, to the Treasurer, Asiatic Society of Bengal, 1, Park Street, Calcutta. Papers submitted for reading at the session of the Congress can only be submitted by Permanent and Sessional members or through Permanent members. No papers are admissible for reading at the Session by any one who has not been enrolled as a member by the 1st October. Papers intended to be read at the Session, must be forwarded together with three copies of an abstract so as to reach the President of the Section concerned *not later than 1st October, 1933.* Abstracts should be type-written and *must not exceed 200 words.* They should not include formulæ or diagrams.

The local secretaries will be Prof. D. D. Karve, M.Sc. Ph.D., Professor of Chemistry, Fergusson College, Poona 4, and V. V. Sohoni, Esq., B.A., M.Sc., Meteorologist, Meteorological Office, Ganeshkhind Road, Poona 5, to whom all enquiries as to accommodation should be addressed.

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*World Petroleum Congress.*—More than one thousand delegates from all parts of the globe are attending the World Petroleum Congress which opened in London on July 19. More than 250 scientific papers will be read and discussed. Dr. Bergius, who has been chiefly responsible for the hydrogenation method of obtaining oil from coal is the President of the Hydrogenation Section. In the course of his statement on the opening day, the Prime Minister said that the Government will assist producers of oil from coal, and this makes it probable that the process developed by Bergius will be worked in Great Britain on a large scale. Though the relative merits of the Petroleum and coal oil industries will not be discussed in the Open Congress, the delegates will have the opportunities of exchanging views concerning the latest developments.

The Petroleum industry is by no means restricted to the production of fuel and lubricating oils. Papers pertaining to the properties and uses of bitumen as a material for road-making and insulating material for electrical instruments, have been listed for discussion. There is a section for discussing problems on the gumming of engine petrols, which leads to engine seizures and on "knocking". The possibilities of the use of alcohol and other petrol-substitutes will also be discussed at the Congress.

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The firm of M. Hensoldt & Söhne, Optical Works, Wetzlar, have, in collaboration with Professor Dr. Max Wolff, of Eberswalde, put on the market a photomicrographic outfit, which will record even difficult microscopic pictures. One outstanding feature of the apparatus, is its compactness, the whole equipment complete with microscope and illuminating device being capable of easy packing in an attached case. This will be a welcome addition to the pocket microscope which the same firm made years ago, and the microscopist who is on his travels—on holiday, on expeditions, and so on—is thus enabled to take photomicrographs thus providing the first perfect solution to the problem of transport of a complete photomicrographic outfit. The apparatus can also be used in conjunction with any existing full-sized stand microscope. A comprehensive catalogue, in English, covering all the specialities, has recently been published, and this can be had in India from their Sole Distributors, the Scientific Apparatus and Chemical Works, Ltd., Agra (U.P.), who have advertised this very apparatus separately in this Journal.

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The Ninth Session of the Indian Philosophical Congress will be held at Poona in December 1933, under the auspices of the University of Bombay. The provisional dates of the Session are the 18th, 19th and the 20th December 1933 and the place fixed for the meeting is Fergusson College, Poona. Mr. V. N. Chandavarkar, B.A.(Cantab.), Bar-at-Law, Vice-Chancellor of the Bombay University, is the Chairman of the Reception Committee and Professors, S. G. Sathe, M.A., I.E.S. (Retd.) and N. G. Damle, M.A., Fergusson College, Poona, are the Secretaries. Professor K. C. Bhattacharya, M.A., of the Calcutta University, has been nominated the President of the Session, and H. H. Sir Chintamanrao Appasaheb Patwardhan, K.C.I.E., Raja of Sangli, has kindly consented to open the Session.

The Session will be divided into four sections, devoted to the discussion of papers on (1) Logic and Metaphysics, (2) Ethics and Religion, (3) Psychology, and (4) Indian Philosophy. Members intending to contribute papers must send them so as to reach the Secretaries or Prof. S. Suryanarayana Sastri, University of Madras, Madras, *not later than the 30th September.* All communications for the Reception Committee may be addressed to Professor N. G. Damle, M.A., Fergusson College, Poona, No. 4.

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The Director of the International Organization of Chemical Documentation has sent us a summary of the Programme, the Office International De Chimie, Paris, propose to carry out. The object of this organization which began its labours in 1932, is to study questions of general interest relating to the International Organization of Chemical Documentation. The work of the Conference of Experts which was summoned, led to the adoption of a certain number of recommendations fixing the three principal tasks of the office: (1) To render accessible to all interested persons, the already existing documentation, accumulated in the various centres, depots and collections; (2) to guide the Chemical Documentation which is in course of production, in such a way as to facilitate its registering, filing and diffusion by methods found to be the best; and (3) to ensure co-ordination between the documentation relative to chemistry and that concerning other scientific knowledge in the field of international documentation.

Thanks to these varied operations. The users of such documentation will find that all over the world a practical and rational organization on documentation in chemistry is being carried on

systematically and progressively, liable to be more and more effectively adapted to their needs.

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Under the auspices of the South Indian Science Association, Bangalore, Dr. A. Nagaraja Rao, D.Sc., delivered an interesting lecture on "Applications of Colloid Chemistry in Industry" on Friday, the 25th August. Dr. B. Sanjiva Rao, M.A., Ph.D., presided on the occasion. In the course of the discourse, the lecturer discussed the application of the principles of Colloid Chemistry in the manufacture of rubber and tanning of leather. The application of the observed influence of small quantities of capillary-active materials on the penetration of tannins, dyes, etc., into various animal and vegetable membranes, in the tanning industry, dyeing of textile fabrics, and manufacture of effective pharmaceutical products, was discussed in detail.

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Under the auspices of the Society of Biological Chemists, India, Mr. V. Ramanathan, Cotton Specialist to the Government of Madras, delivered an interesting lecture on Friday, the 1st September, on the "After Effects of Cholam on Cotton". The problem is being pursued by the specialist under the patronage of the Indian Central Cotton Committee, and is of great practical interest in as much as the existing practice of growing cotton after cholam which the ryot cultivates for fodder results in a loss of nearly 15 per cent. of the cotton crop. The effect is not observed if cotton is grown after a crop of Cumbu. A detailed study of the mechanical and chemical characteristics of the soil has been conducted, and the adverse effects of cholam appears to be traceable to the hardening of the soil which makes deep sowing prior to the sowing of cotton very difficult, if not totally impossible. The lecturer also drew attention to various other observations made, such as the effect of harvesting of the cholam before "seed-setting" on the yield of the following cotton crop, effect of growing other fodders instead of cholam, etc. A practical solution of the problem which is economical and within the practical reach of the ryot is being sought. A good discussion followed.

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*The Chothe Kukis of Manipur:*—Mr. J. K. Bose, Research Fellow, American Museum of Natural History, reports a few interesting observations he made on Chothe Kukis of Manipur, a tribe linguistically classed as old Kukis, whose total strength is not more than 264 heads. They are found only in two villages in two distinct areas. One village is only eighteen miles away from Imphal near Bishnupore by the side of the Cachar road and the other village is just on the Burma border near Tamu. Living in far off villages these people sever all connections with each other. Even in the language of these two people a difference can easily be noticed. The Chothes of Bishnupore are much influenced by their highly cultured neighbours—the Manipuris. In this village they have learnt from the Manipuris the method of plough cultivation and adopted the various implements for it, practically leaving their age-old practice of jhumming.

There are various tales about the traditional origin of this people but among these the tale of an inquisitive monkey who removed a stone from a hole and the ancestors of this tribe came out of this hole and peopled the world is quite interesting.

The Chothes are of moderate stature, with good physique, flat nose and round countenance. The characteristic mongolic fold, high cheekbone and yellowish colour are also very common among them. The girls are healthy and of short stature. They shingle their hair in the Manipuri pattern till their marriage. The deep depression at the root of the nose is remarkable among them.

The relationship system is classificatory and only twenty-four words are used to address different relatives. The term 'apu' is used to address 'mother's brother,' 'father's sister's husband', 'wife's father' and 'father's father'. The term 'api' is used to address 'mother's brother's wife', 'wife's mother' and 'father's mother' and the term 'ani' is used for 'father's sister' and 'husband's mother'. From the use of these above terms a type of cross-cousin marriage with the mother's brother's daughter may be suggested and this is verified from the version of the people who prohibit all other types of cross-cousin marriage except the one mentioned.

Though Col. Shakespeare in his "Lushai Kuki Clans" has noticed five clans among them, we found that the Chothes are divided into six eponymous clans with an interesting type of marriage regulation on the basis of tri-clan system. The clans are Thao, Hiyang, Marim, Piring, Jurung, Mekhong or Marim-mekhong. These divisions are exogamous and they regulate marriage amongst the people. The preferential mate for a man is his mother's brother's daughter and for a woman is her father's sister's son; but now-a-days the rigid rules of marriage are slackened and even in some cases they are allowed to marry girls from other tribes. In one of the genealogies we find that 'Luithang' a Chothe Kuki first married a Chothe girl and then after some years wanted to marry again but no girl was available for him within the village. He then, with the permission of the village officers, married a girl of Wainem tribe from Tipperah. This girl was then adopted as the clan-sister of his former wife and she was not debarred from joining in any of the social or religious festivities of the tribe.

* * *

Mr. Jatindra Mohan Datta, writing on the subject of Polyandry, draws attention to a type of "Qualified or Limited Polyandry" existing in the district of Rajshahi in northern Bengal. This is found among the *Bausphors*, a low Musulman caste, who pledge their wives to other men. Any children born while they are so pledged are divided equally between the pledger and the pledgee. During the continuance of the pledge, the pledger-husband has occasional access to the wife, especially at the time of periodical payments of interest and at ceremonial occasions in the family of the pledger-husband. On full repayment of the debt the wife is redeemed. However, on the death of the pledgee, the woman observes mourning similar to that observed on the death of her own husband, but only for a shorter period and in a less intense form. If, before the debt is repaid, the pledgee dies, his family retains the woman until the balance is paid, but no one has any right of access to her.

As Polyandry in any form is not recognised under either the Hindu or the Muhammadan systems of Law and as adultery is punishable with imprisonment for 5 years, the practice is dying out.

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An ordinary meeting of the Association of Economic Biologists, Coimbatore, was held on July 20 when two papers entitled (1) "Some introduced weeds of South India" by C. Tadulingam and G. V. Narayanaswamy and (2) "A Haploid Plant in Rice" by K. Ramiah, N. Parthasarathi and S. Ramanujam, were read and discussed.

Dr. C. D. Darlington, D.Sc., Ph.D., Cytologist, John Innes Horticultural Institution, London, who was on a short visit, visited all the plant breeding sections at Coimbatore. He was entertained at tea by the Association of Economic Biologists, on the 13th August and before leaving for Colombo, the same evening, delivered an interesting lecture on "Chromosomes and Plant Breeding" to the members of the Association.

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An ordinary monthly meeting of the Asiatic Society of Bengal was held on Monday, the 7th August, at 5-30 P.M., when two papers, one by Mr. Harit Krishna Deb on "A Newly discovered Asokan Pronouncement" and another by Mr. Himansu Bhushan Sarkar on "Date of Introduction of the Saka Year in Java", were read. An exhibit from Mr. Baini Prasad—"A Habitat Group of Indian Storks" was shown and a few remarks on its preparation made. Specimens of "the Snail, *Rachisellus punctatus* (Anton), in summer sleep," were exhibited by Dr. S. L. Hora, and were commented upon.

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In view of some enquiries regarding Life Subscription for *Current Science* it is hereby notified for the information of all those interested that the Life Subscription is Rupees *One Hundred Only* (Rs. 100).

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The news of the appointment of Prof. Hans Pringsheim of Berlin, as Professor of Technology in the Andhra University has reached us, as we are going to the Press. Prof. Pringsheim is a specialist in sugar, starch, cellulose and fermentation with wide industrial experience, and his appointment will be received with great jubilation all over India. We welcome him to India and congratulate the authorities of the Andhra University for obtaining the services of so eminent an Industrial Biochemist.

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We acknowledge with thanks the receipt of the following:—

"Nature," Vol. 132, Nos. 3324 to 3327.

"The Chemical Age," Vol. 29, Nos. 733 to 736.

"The Scientific Indian," Vol. 10, No. 55.

"University of Cambridge School of Agriculture Memoirs." No. 5.

"Canadian Journal of Research," Vol. 8, No. 6.

"The Journal of Chemical Physics," Vol. 1, No. 7.

"The Indian Forester," Vol. 59, No. 8.

"The Biochemical Journal," Vol. 27, No. 3.

"Experiment Station Record", Vol. 67, Index Number.

"The Review of Scientific Instruments," Vol. 4, No. 7.

"Proceedings of the Conference of Medical Inspectors of Schools, Madras," 5th and 6th August 1932.

"Proceedings of the Academy of Natural Sciences of Philadelphia."

"The Journal of Nutrition," Vol. 6, No. 4.

"Bureau of Education, India," Pamphlet No. 30, 1932.

"Berichte Der Deutschen Chemischen Gesellschaft," 66 Jahrg. No. 8.

"Journal de chemie Physique," Tome 30, No. 6.

"American Journal of Botany," Vol. 20, No. 7.

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A great impetus to Industrial Development in Central Provinces has been given by the passing of the State aid to Industries Bill. It is a matter of common knowledge that the condition of many of the important organised industries in the Province such, for example, as the textile industry, oil industry, glass industry, cement and soap industry, have been considerably affected either through foreign competition or necessity to import main raw materials from outside, which brings the cost of production to a high figure. The manganese industry is in a deplorable condition and many of the shellac factories have been closed down. The cottage industries, as in other parts of the country, suffer mainly through the lack of organisation to sell the products, or seek information regarding the needs of the urban buyer. The Department of Industries is no doubt helping the indigenous industry by organising exhibitions and conducting propaganda. The Bill which has been recently passed in the Council seeks to give aid to deserving industries by (1) granting loans, (2) guarantee of cash credit, overdraft or fixed advance, with a bank, (3) guarantee of a minimum return on the whole or part of the capital of a joint stock company for a fixed period, (4) the grant, under favourable terms, of land, raw materials, etc., (5) the grant, free of charge or under favourable circumstances, of the service of experts or Government officials for starting or advising on an industry, and (6) payment of subsidies for the conduct of research or the purchase of machinery.

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## Reviews.

ELEMENTS OF OPTICS. By Dr. J. Valasek. (McGraw-Hill Book Company, 1932. Pp. xv+ 254. Price 13*s*. 6*d*. net.)

The book under review is intended to supply the need of the junior students in college classes for an elementary text-book on optics. With the rapid advances of science in general and physics in particular, has increased the demand for text-books which present the full scope of the subject striking a proper balance between the old and the new. This is especially difficult in optics—" the centre of activity in physical research "—where the recent discoveries have so revolutionised its scope that no book on the subject would give the proper perspective if it did not deal with the modern developments which have bridged the gulf between the corpuscular and the wave theories.

The first nine chapters of the book are entirely devoted to a clear exposition of Geometrical Optics and include also such interesting topics as colour photography and television. The reader is first introduced to the wave aspect of light in chapter IV and this has led to a dual treatment of Reflection and Refraction in the succeeding chapters. Chapters X to XII deal exclusively with the consequences of the wave nature of light. Chapter XIII on Radiation is a fairly comprehensive, though elementary, treatment of the problem in all its aspects. Here the student is first introduced to the makers of modern physics who have been responsible for the solution of the riddle of atomic structure. In this up-to-date treatment of the subject, the more recent notation for spectroscopic terms might have been more appropriately adopted. The next chapter gives an elementary exposition of the theory of relativity and leaves the uninitiated student in doubt as to its place and function in an elementary text-book on optics. The concluding chapter is a broad survey of the theories regarding the nature of light and ends in a rather philosophic note, with a mystical touch. Select problems and a comprehensive appendix form a special feature of the book.

The author must be congratulated for successfully presenting a book which blends the classical and the modern ideas in a way useful to the student beginning his college career. The popularity of the book would no doubt be enhanced by a more moderate price. The get-up of the book leaves nothing to be desired. The book is an excellent introduction to Optics and we heartily recommend it to junior students in Universities.

* * *

THE NEW BACK-GROUND OF SCIENCE. By Sir James Jeans. (Cambridge University Press. 7*s*. 6*d*. net. 1933.)

The present century has witnessed such a new orientation of scientific thought as could not have been even dreamt of by an exponent of the mechanistic views of Nature so firmly established in the previous century. What Lord Kelvin saw as two small clouds that were visible as two small specks on the fair horizon of the Physics of the last century have developed into huge storms that have swept away most of the highly cherished and apparently unassailable picture of the universe which two hundred and fifty years of inquiry following Newton had filled in. One of these is the Quantum Theory due to the genius of Max Planck and the other the Relativity Theory which Einstein gave to the world. The luminiferous æther of Faraday and Maxwell was denied its claim to reality and a broad synthesis was effected by uniting space and time into a single entity whose geometrical properties provided an accurate representation of gravitation and of electricity. The Quantum Theory in the hands of Planck, Einstein and Bohr made clear many hitherto obscure facts of fundamental importance, but it was a thing apart whose connection with the older and well-established wave theory was a big puzzle. The brilliant synthesis effected by Heisenberg, De Broglie, Schrödinger and Dirac solved this puzzle, but raised other more fundamental questions that affect Physics as well as Philosophy. The law of causality, the nature of the external world, its objective reality and the doctrine of free will have all lost their original claim to our implicit belief, at least in the form in which they were familiar to us, and a new philosophy directed by Science is in the process of formation. The common sense picture of the world has failed to give a faithful representation of reality as a whole, and a picture in terms of new mathematical symbols and equations is the only representation that has so far stood the test of experiment. While Physics is thus becoming less and less easily intelligible in terms of every-day ideas, the demand on the part of the layman for a knowledge of

its present state is becoming more and more insistent. Einstein's paper on a new unified field theory became a best-seller in spite of its being absolutely unintelligible to the layman. This enormous increase in public interest in Physics has been attributed to the failure of religion to satisfy the modern mind and the desire for a proper substitute. However, the need for clear and, if possible, non-mathematical accounts of modern Physics has been felt even by many physicists themselves. In the ability to satisfy such a demand adequately and with authority no one is better qualified than Sir James Jeans. His presentation is something inimitable and his style most charming. This has now become common knowledge and the popularity of his books is a true testimony to the excellence of his writings. In this new book Sir James has given a most stimulating account of the development and present state of the special and general theories of Relativity as well as of Quantum and Wave Mechanics. We already owe to Sir James himself some illuminating disquisitions on the Relativity Theory, but nothing quite like his presentation of Quantum and Wave Mechanics has so far been available to the average reader. The freshness of the outlook and the keenness of the analysis is matched only by the felicity of simile and illustration from facts of every-day life. Even men of science can but profit from a perusal of the book, since the philosophical implications of the new theories have been detailed by a master hand. In the book "Where is Science Going" of Planck, Einstein is represented as telling Murphy that Jeans is fundamentally quite in agreement with other physicists with regard to the Physics, although he may be at variance in respect of its philosophical meaning. In the present book, however, the agreement is more pronounced than the variance, and the quotations which Sir James has given from Planck's book show that he agrees with other scientists in all essentials, and only differs on occasions in respect of predictions as to the future course of Physics. There seems to be, however, an emphasis on the view that matter may after all turn out to be of the nature of mind. But whether he agrees or not his views are presented with such persuasive logic that it is difficult not to agree with him. We heartily recommend the book not only to the layman interested in Modern Physics but even more so to Physicists who require a tangible and authoritative exposition of the implications of recent Physical theories and speculations.

* * *

REMEMBERING: *A Study in Experimental and Social Psychology.* By F. C. Bartlett, M.A., F.R.S. (Cambridge University Press. Price 16*s*.)

This book forms a worthy contribution to a distinguished series of the Cambridge Psychological Library. It is a study based on experimental observations extended over a period of about twenty years. A theory of *remembering* is developed in this book which gets rid of the notion that memory is primarily a reproductive or repetitive function. "Remembering is not the re-excitement of innumerable fixed, lifeless, fragmentary traces as usually supposed. It is an imaginative reconstruction depending on our attitude towards a whole mass of organised past reactions. What we call memory traces are interest-determined and interest-carried. They live with our interests and change with them." If memory itself is constructive how are we to distinguish it from constructive *imagination?* Mr. Bartlett is not unaware of the above objection. He points out that the chief differentiating marks are to be found in the range of material and the precise manner of their control. Remembering is schematically determined. In imagination, construction develops, as it proceeds. In constructive *thinking*, however, we come back to greater rigidity of control.

Mr. Bartlett's theory of Remembering brings remembering into line with *imaging*. More important still, it gives to *consciousness* an important function, it enables the organism to escape from the sway of immediate circumstance, to respond to stimuli at a distance—a function that cannot be equally well accomplished by any purely physiological process. In the face of the function now definitely assigned to *consciousness* by Bartlett, the Behaviourist account of *consciousness* becomes increasingly untenable.

M. V. GOPALASWAMI.

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ACHARYA RAY COMMEMORATION VOLUME. (Calcutta, 1932.)

Sir Prafulla Chandra Ray holds a unique position among scientific men in India not only because he is the founder of a very flourishing school of Chemistry in Calcutta

but also for his work in inspiring and pioneering several flourishing industries, such as the Bengal Chemical and Pharmaceutical Works, the Bengal Pottery Works, the Calcutta Soap Works, the Bengal Canning and Condiment Works, etc. In addition he has done most valuable work for social reform, in the cause of education and other activities which are fully detailed in the Foreword by the President of the Board of Editors of Acharya Ray's Commemoration Volume which was conceived as one of the tributes to be paid to the savant's septuagenary celebration on the 11th December 1932. The Board of Editors, as is explained in the Foreword, decided to bring out "a handsome volume dealing broadly, among others, with such subjects as science, literature, economics and industries, sociology, religion and philosophy" and invited contributions in Bengali, English, Hindi and Sanskrit. The beautifully got up volume of 615 pages, with two portraits of Sir Prafulla, 17 plates and numerous text-figures, is the result of the untiring efforts of a distinguished Board of Editors and, more particularly, of Dr. Satya Churn Law, the Honorary Secretary. It would probably not be out of place to mention here that but for Dr. Law who volunteered to bear the entire expense in connection with the publication of the volume and devoted a great deal of time and energy to it, the work might not have appeared in its present form.

In the volume there are 74 articles by men of various nationalities from different parts of the world. As is natural in a work of this type, almost one-third of the articles deal with one aspect or another of Sir P. C. Ray's work and a fair number of them are in the nature of appreciations of his multifarious activities. Amongst special contributions of this type one has to mention articles by such distinguished personalities as Dr. H. E. Armstrong, Sir J. C. Bose, Dr. M. O. Forster, Dr. G. J. Fowler, Mr. M. K. Gandhi, Dr. Rabindra Nath Tagore, Mr. Ramananda Chatterjee, and others. All these articles clearly indicate the high regard, affection and respect in which the distinguished scientist is held not only by his countrymen but by workers all over the world.

Amongst general contributions may be classified such articles as deal broadly with scientific, economical, industrial, sociological and philosophical problems. Of roughly 20 such articles, a few may specially be mentioned:— Principal Bhattacharyya on Sanskrit Treatises on Alchemy which have been translated into Tibetan, Dr. De on "The Hindu College and the Reforming Young Bengal," Dr. S. R. Das on "Time in Ancient, Mediæval and Modern Chronology," Mr. L. Gupta on "The Singbhum China Clay Industry," Dr. H. Haldar on "Rammohan Roy's Conception of Universal Religion," Dr. R. C. Majumdar on "The Spirit of Exploration and Adventure in Ancient India," and Dr. M. N. Saha on "Need for a Hydraulic Research Laboratory in Bengal". There are also a number of high-class literary articles of which "Tansen as a Poet" by Dr. S. K. Chatterji and "Bengali Manuscripts at Evora" by Dr. S. N. Sen deserve special mention. Of the contributions on physical science, reference may be made of Dr. T. Morgan's paper on "Experimental Researches on Co-ordination," Dr. Armstrong on "The Future of Chemistry in India," Mr. N. C. Nag on "Micro-Chemical Method for Detection, Separation and Estimation of Nickel and Cobalt," Dr. B. K. Singh on "The Doctrine of Symmetry in Chemistry and its Significance to Molecular Configuration" and Dr. M. K. Srinivasan on "The Preparation of Manganese Dioxide Sol.". The number of biological contributions in the volume is comparatively large—almost one-fifth of the total contributions—and these deal with such abstruse subjects as an account of the Theories of Sex in Fungi, Rôle of Aquatic Vegetation in the Biology of Indian Waters, Pre-Linnæan Writers on Indian Zoology, Structural Adaptations of various animals, Voice of Insects, Identification of birds in Kalidasa's writings, Importance of the study of Embryology, etc.

The work in general constitutes a very valuable production and deserves all commendation. The only drawback that the reviewer finds is that the Board of Editors, probably in trying to publish almost all the contributions received in response to its appeal, has not used its discretion in refusing some of the less suitable articles, while the privilege of using the editorial pen does not seem to have been exercised in most cases. B. P.

* * *

THE METHODS OF CELLULOSE CHEMISTRY. By Charles Doree. (Chapman and Hall, Ltd., London, 1933. Price 21*s*. nett.)

The above is a highly useful contribution to an important branch of science, the

application of which has progressed ahead of the related analytical methods.

The author, who has had several years of active experience in the line, deals with the subject in a refreshingly intimate manner. The first few chapters are devoted to the preparation of pure cellulose and the methods of investigating transformations that attend its treatment under various conditions. Particular attention is devoted to the physical and physico-chemical methods which have come into considerable prominence in recent years. The following chapters are devoted to the properties and behaviour of oxy- and hydro-celluloses the technical importance of which are now being increasingly realised. The degradation products of cellulose and their bearing on the structure of related carbohydrates are also described in some detail. A useful chapter is devoted to the detection and estimation of the extent of damage to cotton and linen and other cellulosic goods through various agencies.

The second part of the book deals with synthetic derivatives of cellulose which have come to play such a large part in industries in recent years. The methods of investigating the different cellulosic esters are also described in careful detail.

The third section deals with compound celluloses. This portion relates to the fundamental relations between the naturally occurring cellulosic materials and could, perhaps, more appropriately form the opening chapters of the book. Various methods employed for the examination of celluloses and lignins and related products are described in careful detail: The chemistry of lignin and peptic substances are also dealt with at some length. The text is followed by a few tables and a good index.

The book is definitely an advance on most of the other publications on the subject which have appeared in recent years. It is not, however, free from certain defects which characterise many books on analytical chemistry. The author has, presumably, tried many of the methods that he describes but has refrained from commenting on them. This is rather unfortunate because there are numerous methods for the examination of cellulosic materials most of which are either highly defective or have only restricted application. The student of cellulose chemistry would, therefore, have welcomed the personal touch of the author after the description of each method. A few lines indicating the merits and demerits of the different methods with some suggestions for successful handling of the products would have greatly enhanced the usefulness of the book.

The text is presented in a readable style. The matter is printed on good paper and that combined with freedom from type mistakes is highly complimentary to the efforts of the publishers. The price is quite reasonable and considering its usefulness it may be said that the volume deserves to be in the hands of not only those engaged on the analysis of cellulosic materials but also those engaged on researches in the related subjects.

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UN LAC ACIDE DE MONTAGNES ANCIENNO. LE LAC DE LISPACH, DANS LES VOSGES. ETUDE HYDROBIOLOGIQUE. By E. Hubault. (*Ann. Ecol. Eau. For St. rech. exp. for.* Tom IV, fas. 2. 1932.)

In this interesting paper M. Hubault reports the result of his study on the fauna of an acid lake in France. In addition to hydrogen ion concentration, he has studied the oxygen content, temperature, total quantity of electrolytes, phosphate and silicate contents of the water. Regarding fauna he has restricted himself to zooplankton.

The pH at a depth of 5 meters varied from 5·3 to 5·7, which indicates that the water there was fairly acid. Near the surface the pH was 5·8 to 6·5, that is, the water was quite near the neutral point. It would, therefore, have been very interesting if the author had enumerated the fauna of the two strata separately.

The comparison of the fauna of the acid lake with those of other lakes in the neighbourhood shows that the fauna of this lake has several interesting features. The Peridiniem *Ceratium hirundinella* common in other lakes is absent in the acid lake. The Rotifers are represented by very few species. Of the insects and fishes, only *Chironomid larvæ* and *Salmo fario* respectively were obtained.

H. S. P.

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A MANUAL OF PRACTICAL INORGANIC CHEMISTRY. By Dr. E. H. Riesenfeld, Professor at the University of Berlin. Translated by Prof. P. Ray, M.A., University College of Science, Calcutta; being an authorised translation of the latest German edition of Anorganisch-chemisches. (Praktikum. Pp. xxiii + 471. Chuckervertty, Chatterjee

& Co., Ltd., 15, College Square, Calcutta, 1933. Price Indian Rs. 6; Foreign 9s.)

This book is intended to serve the needs of beginners in qualitative analysis and inorganic preparations.

In addition to prescribing the conditions under which the tests for radicles are to be applied, this book provides information regarding the sensitiveness and reliability of several important reactions of the ions. The methods of separation of the commoner elements are described in a manner which will enable the student to choose and apply the particular method which is likely to be most suitable to his purpose. The inclusion of some microchemical tests and "spot reactions" makes this book particularly useful.

The sections dealing with inorganic preparations have been judiciously distributed throughout the book and provide valuable hints concerning the manipulative operations involved therein. Sixty-two exercises are set out in detail and these include almost all the typical inorganic compounds.

A most praiseworthy feature of this book is the easy manner in which it introduces the reader to questions of theoretical importance such as complex salts, allotropy and isomerism. This book fulfils all the requirements of a text-book of practical chemistry and can be heartily recommended for general use in college classes.

K. R. K.

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STUDIES IN MASS PHYSIOLOGY: *The Effect of Numbers upon the Oxygen Consumption of Fishes.* By F. Schuett. (*Ecology*, XIV, pp. 106-122. 1933.)

In this important paper the author shows that when four fishes are present in a given volume the amount of oxygen consumed per fish is lower than the amount consumed by an isolated fish in the same volume. This phenomenon of "group effect" has been observed by the author in 4 genera of non-schooling fishes and he suggests that it may be a general rule for all such fishes.

Regarding the reasons for the 'group effect' the author concludes that factors such as low pH, accumulation of $CO_2$ or reduction of oxygen tension do not appear to be important. He shows that within considerable ranges the oxygen consumption is independent of the oxygen tension of the medium down to near the asphyxial level. According to the author delicate and subtle biotic mechanisms work within the confines of a restricted environment, which produce definite and important changes in the interactions within a community living in the environment. The exact nature of the biotic mechanisms is not known and the author promises to throw some light on the subject after completing some more investigations.

H. S. P.

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SOME PTERIDOSPERMOUS PLANTS FROM THE MESOZOIC ROCKS OF S. AFRICA. An important contribution to our knowledge of the Mesozoic flora is embodied in a recent paper by Dr. H. H. Thomas (*Phil. Trans. Roy. Soc.*, Ser. B, 222, 1933) dealing with a well preserved collection of plant fossils from the Molteno beds of Natal. The material was collected from the sandstones, grits and dark shales, forming the base of the Stormberg series—the uppermost subdivision of the Karoo system. This area has been thoroughly mapped and described by Dr. A. L. Du Toit and on several decisive evidences, these plant-bearing Molteno beds are regarded as middle Triassic in age.

The material described by Dr. Thomas in his paper consists of about 30 specimens of seed-bearing structures, 25 specimens of pollen-bearing structures and a large number of isolated seeds. After a very detailed and careful examination of all this material, Dr. Thomas has been able to establish a new family *Corystospermaceæ* and define four genera in this family—*Umkomasia*, *Pilophorosperma*, *Spermatocodon* and *Pteruchus*—the first three of which have been based on the study of the female inflorescences and the last one—*Pteruchus*—on the study of the male inflorescences. The seeds are gymnospermous borne in cupules on the ends of branches forming a regular inflorescence. A detailed account of the form, character and cuticle structure of the cupules, as also the cuticle structure of the epidermal cells has been given in each of the genera and several species have been diagnosed—2 species of *Umkomasia*, 8 of *Pilophorosperma*, 1 of *Spermatocodon*, and 8 of *Pteruchus*. The author next passes on to certain morphological considerations which lead to a discussion of such vital problems as our concept of the 'sporophyll' in connection with the origin of the reproductive structure, the ancestry of the Caytoniales and their relation to Pteridosperms, and the relationship between the Pteridosperms and the

flowering plants. On the strength of his present work, Dr. Thomas asserts that the concept of the "seed-bearing leaf" is an illusion and suggests that gymnospermous seeds (like those of *Corystospermaceæ*) must be regarded as terminal structures formed at the ends of branches and not as marginal structures borne on a typical foliar organ. The present study of the *Corystospermaceæ* has also served to provide further grounds in support of the suggestion made by Dr. Thomas himself in 1925 that the Caytoniales as a group may be derived from the palæozoic pteridosperms by the closing of the cupule, and thus confirms the author's belief in the derivation of the modern angiosperms from the same group. On the whole there is no doubt that the paper forms a very valuable contribution "towards the elucidation of the nature of the floras of Mesozoic times and of the affinities and systematic position of the plants composing them." L. R.

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METALS (All about Metals). By R. N. Bhagvat, M.A., B.Sc., Professor of Chemistry, St. Xavier's College, Bombay. Pages vi+222. (Published by the author. Price Rs. 3-0-0.)

"The following some two hundred pages are devoted towards giving something of everything of the chemistry of metals in as non-technical a language as could possibly be done without any way harming the scientific side of the subject. Quite a number of tables are given to give at a glance the comparative merits and demerits of different metals when put side by side. These tables are made as eloquent of their purpose as possibly they could be done so and I believe would be found very useful and instructive."

The extent to which the author has succeeded in not in "any way harming the scientific side" can be gathered from the following passages, which are just typical examples of the thousands scattered throughout the book.

P. 27. "When *in bulk* the metals reflect light from polished or freshly cut surfaces, and this is called the *Metallic Lustre*. Most of the metals when very finely powdered are black, except magnesium and aluminium which have shining appearance."

P. 38. "Pure zinc is scarcely affected by acids, because the hydrogen first formed adheres to the metal in a thin, continuous film which prevents the acid from coming into further contact with it. In generating hydrogen in the laboratory it is usual to avoid this difficulty by adding a few drops of a solution of copper sulphate to the glass bottle containing zinc and water before introducing the acid. *This coats the zinc with copper, from which the hydrogen produced, when the acid is added, escapes without difficulty.*"

The book contains many printing mistakes, and the style and grammar could do with some improvement.

P. 12. "It thus happens that chemists have not always agreed as to the arrangement of the elements in this subdivisions" (metals and non-metals) .... "But arsenic has a distinct relationship to antimony which is universally included among the metals (according to some) ...."

P. 13. "In ores the proportions of the chief metals are quite varying in as much as in iron mining, half the weight of the ore has to be iron to make it a good ore, while a copper ore with even less than two per cent of the metal is worth mining."

We do not see much merit in this book, excepting that it is neatly got up. The paragraph on p. 9 referring to Charaka's idea of metals is very unæsthetic, and could certainly have been avoided. The book, however, contains a certain amount of useful information, which if presented in a greatly revised form, will be welcomed as a 'general' book both for the student and the layman.

G. R.

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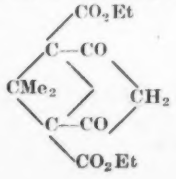
## Erratum.

*Current Science*, Vol. II, No. 2, August 1933, page 53, right-hand column, Formula I.

*For*




*read*